



# The Dock and Harbour Authority

No. 262. Vol. XXIII.

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AUGUST, 1942

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## Editorial Comments

### Savannah.

With a swing of the pendulum, we pass from the Old World to the New—from the ancient City of Athens and its port, The Piræus, founded long before the commencement of the Christian Era, to a port on the Western shores of the North Atlantic, scarcely more than a couple of centuries old. Savannah, the subject of this month's leading article, was settled by an English expedition under General Oglethorpe in February, 1733. It is now the chief city and port of the State of Georgia and a notable cotton port. At one time, indeed, the second cotton port in the United States, it has since been surpassed in exports of the commodity by more southerly ports, notably New Orleans, Galveston and Mobile, but it still maintains an important trade, inclusive of lumber, and iron and steel manufactures.

The description of the port in this number and the particulars of its accommodation and the facilities for shipping are extracted from a recent monograph by the United States Army Corps of Engineers in their Port Series, to which we have previously been indebted for similar information about other American ports. Necessarily omitting a good deal from this admirable and exhaustive publication, we hope we have been able to present some interesting facts about the port and its activities.

The history of Savannah includes a siege and capture in the eighteenth century and two great conflagrations, each of which did great damage, of the order of a million dollars and more. During the Civil War, the city was the object of stern contest between the opposing forces and suffered accordingly.

Coming to current times, it is appropriate as well as interesting, to note that the recent proclamation by President Roosevelt respecting the observance on May 22nd last of National Maritime Day in the United States, commences with the preamble: "Whereas on May 22nd, 1819, the steamship *Savannah* sailed from Savannah, Georgia, on the first successful transoceanic voyage under steam propulsion, thus making a material contribution to the advancement of ocean transportation," etc.

The voyage of the *Savannah* was, indeed, a notable event in the history of navigation. She was, however, essentially a sailing ship and it is recorded that steam power was employed for only 80 hours out of the 25 days of the voyage. Her captain, Moses Rogers, nevertheless achieved distinction both for himself and the vessel and the event created a great sensation at the time.

Savannah, it may be confidently hoped, will continue to make similar records of enterprise and commercial activity in the future.

### The New York Foreign Trade Zone.

It was announced in the Notes of the Month in our last issue that, in consequence of the appropriation by the United States Government of the four piers at Staten Island, occupied for the purpose of a Free Port or Foreign Trade Zone, it would be necessary to search for an alternative site for the zone. This has now been found at Piers Nos. 72, 73, 74, 75 and 84 on the North River at Manhattan Island and the operations of the zone have been transferred thither.

Speaking at the Annual Convention of the American Association of Port Authorities in November last, Mr. Thomas Lyons, Executive Secretary of the Foreign Trade Zones Board, said that the annual report of the City of New York for the calendar year 1940, covering the work at the zone, reflected a continued improvement in its fiscal position and general operation. The facilities and services of the zone were utilised to their fullest extent during the entire year. While trade with Germany, Japan and Mid-Europe had ceased, the movement of merchandise from South American countries, China and the Netherlands East Indies had grown extensively.

The statement in the last sentence would require considerable modification at the present time. The Chinese and East Indian markets have been temporarily lost, for how long it is impossible to say, but it is not unlikely that opportunities will have presented themselves in other directions to compensate for this abstraction of trade.

Mr. Lyons called attention to resolutions passed at the Washington meeting of the Inter-American Maritime Conference on November 23rd, 1940, which were as follows:—

"1. To recommend to the Inter-American Financial and Economic Advisory Committee and through it to the governments of the American republics, that they consider the establishment of free ports in those places which because of their privileged geographic situation, and existing or easily developed means of communication, may appear to be most advantageous for such establishments.

"2. To recommend to the shipping companies represented at this Conference, that they co-operate with the governments of the American republics in the study of this important matter, offering the facilities which they may have available and especially those which tend to solve the problem of double maritime freight rates arising from the necessity of shipping merchandise to the free port and from the latter to its final destination."

**Editorial Comments—continued****Shipowners and Port Charges.**

The annual report for 1941-42 of the London General Shipowners' Society, which was presented to the annual general meeting of members on July 29th, contains a number of topics which impinge upon port administration, and especially in regard to charges on shipping. Making reference to the increases in rates and dues which have been imposed by the Port of London Authority since March last, viz.: 20 per cent. for discharging vessels and other services and 15 per cent. (apart from rental) on import goods and goods for shipment, the Committee of the Society state that they are not satisfied that the increment in cost has been fairly apportioned as between vessels and goods, and some correspondence on the matter has taken place between the Society and the Authority. The additional charges, it may be explained, have been necessitated by the extra expense involved in giving effect to the Essential Work (Dock Labour) Order, 1941. The Authority have replied that the charges in question are provisional and will be reviewed after a trial period of six months.

As regards the gross amount of additional expense incurred, the main consideration of a port authority under such circumstances must be to recoup themselves for the enhanced cost of labour. From the shipowners' point of view, as also from that of the merchants, the actual allocation between ships and goods is a matter of prime importance. Logically and ideally, rates on shipping and dues on goods should be imposed in proportion to the precise services rendered in each case, that is to say, broadly speaking, the cost of berthage accommodation and facilities in the former instance, and of cargo handling and storage on the other. But the boundary line between the two sets of services is not so clearly definable that a certain amount of controversy may not arise, and it is further complicated by the fact that cargo handling may or may not be performed by the parties themselves. At any rate, in practice, there is room for considerable divergence of opinion. Thus, some ports cut the Gordian knot by adopting a somewhat arbitrary ratio of 50-50, that is, dividing the charges equally between the parties, while, at other ports, the respective percentages vary between 30 and 70, according to local views and the particular circumstances. The subject is too involved for further discussion here.

Another topic dealt with was the prevalence of pilferage at ports. The Committee state that in conjunction with the Dock and Harbour Authorities' Association, strong representations have been made to the Home Office on the inadequacy in many cases of the sentences imposed on offenders, in consequence of which an official communication has been sent to magistrates in dock areas. The Committee's conviction is that the most effective line of attack would be on the receivers, who are indirectly responsible for nearly all the more serious cases of theft.

**Recuperation Centres for Unfit Dockers.**

One of the several causes of "absenteeism" among dock workers is stated to be the indifferent state of health of those men who are only partially recovered from sickness and yet have to return to work, being no longer in receipt of sick pay. As a means of overcoming this disability, and at the same time, improving the general condition of semi-disabled men, an experimental "rehabilitation centre" is to be opened at Claremont, Pendleton, Lancashire, where the men can continue to receive medical treatment and benefit from rest and relaxation in healthy surroundings until they regain physical fitness. A medical superintendent will be in charge and the equipment will include a gymnasium. Men who are not sufficiently recovered from illness to stand up to the strain of a week's continuous hard work, will attend daily, and during their absence from duty, their families will receive an allowance of 50s. per week. The centre at Claremont is able to accommodate 50 men.

The idea is commendable, both on humanitarian grounds and also as a matter of policy. It has been stated by Alderman J. A. Webb, Manchester Area Secretary of the Transport and General Workers' Union, that enquiries at the Manchester docks have shown a higher proportion of time lost through the after-effects of illness than through accidents and injuries. The Ministry of War Transport has been consulted in the matter and has approved the scheme.

**The Cape Town Graving Dock.**

Operations in connection with the design and construction of the large new graving dock at Cape Town are now well in hand, and the work is being pressed forward with the utmost speed. It is obvious, however, that the period of construction will be protracted—it is estimated at 2½ years—though every effort will be made to shorten it as much as possible.

It will be recalled that the British Government has offered to contribute a sum of £750,000 (sufficient to provide for the pumping plant and caissons), towards the total estimated cost of £2,034,000. An interesting suggestion has been put forward by the *Johannesburg Star* that "South Africa's self-reliance has surely reached the stage which would permit us to dispense with financial aid from Great Britain in the cost of lock building at our ports." The *Star* continues:

"Relatively, the Union is probably in the strongest financial position of all the Commonwealth countries, and her war expenditure in relation to national income is comparatively low. According to figures given in the Assembly recently by the Minister of Finance, the War Bill last financial year represented only just over 12 per cent. of the national income, as against 40 per cent. for Great Britain, 25.5 per cent. for Canada and 22 per cent. in Australia. And our level of taxation is also on a much lower scale. In the light of these facts, a decision to bear the whole cost of the Cape Town dock—which will be ours in perpetuity—would be a pleasing gesture, and yet how trivial in contrast with Canada's recent great-hearted gift to Great Britain of a thousand million dollars in war supplies."

Of course, three-quarters of a million sterling is only a small fraction of the 12 to 14 millions a day which this country is spending on the war effort. Astronomical figures convey little to the mind unaccustomed to think in millions, but as everything which helps to relieve the colossal financial burden borne by this country is welcome, the proposal, if it should be approved by the Union of South Africa, could not be otherwise than gratefully acceptable to the British taxpayer, though he would not wish to press any claim in the matter.

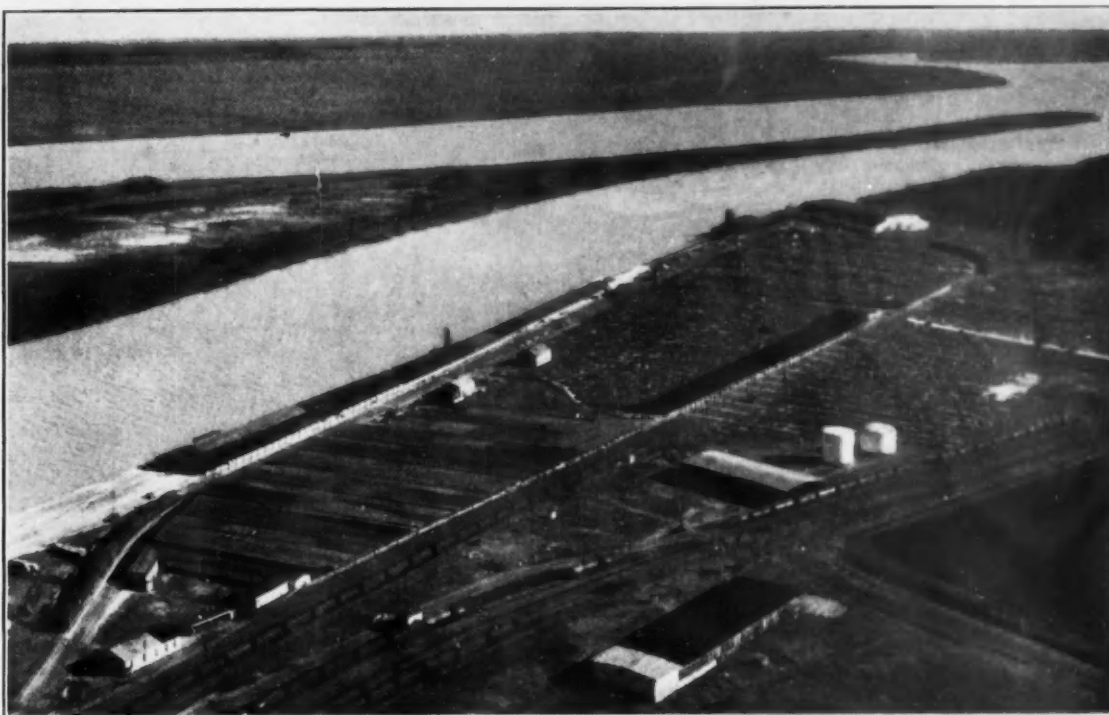
**A Notable Dry Dock Model.**

While on the subject of the Cape Town Graving Dock, it is of interest to mention that a fine large model, 8-ft. in length, of the dock has been made to scale showing the Union-Castle Line's finest vessel, *Cape Town Castle*, in position on the keel blocks. The assumption has been made that the dock will be 1,250-ft. long and 150-ft. wide. The dock-model has two compartments, an outer chamber of 720-ft. and an inner chamber of 500-ft. This necessitates two caissons, one for closing the entrance and the other for separating the two chambers. The model also shows the buildings housing the pumping plant and caisson-hauling machinery. Along each side of the dock is a crane track with two sets of railway lines.

**The 30th Convention of the American Association of Port Authorities.**

Very belatedly, mainly in consequence of difficulties arising out of the war, we have received the official account of the Proceedings at the 30th Annual Convention of the American Association of Port Authorities held in Florida last November, under the presidency of Mr. Eloi J. Amar. Much water has flowed under many bridges since that date, but we propose to publish some of the addresses which were given, and papers which were read, during the sessions of the Convention, attended, as it was, by numerous representatives and delegates from ports in the United States and Canada. Our readers will have to make due allowance for the pre-war status of the former country, as manifested in some of the expressions used by the speakers.

We commence with an introductory address given by Colonel Bragdon, Division Engineer of the Corps of Engineers, United States Army representing General Reybold, the Chief of Engineers, whose organisation is entrusted with the maintenance and the development of harbours in the United States. It is an interesting survey of conditions which prevailed therein, immediately prior to the outbreak of active hostilities.



Lower Section of Atlantic Coast Line Railroad Terminal

## *The Port of Savannah*

### *Leading Port of the State of Georgia, U.S.A.*

#### General Description

**S**AVANNAH HARBOUR entrance is 75 miles South of the entrance to the Port of Charleston, S.C., 70 miles North of the entrance to Brunswick Harbour, Georgia, and 120 miles North of the mouth of St. John's River, on which is the Port of Jacksonville. It comprises the lower 22.4 miles of Savannah River and 7.2 miles of channel across the bar to the 30-ft. contour in the ocean. The City of Savannah is located on the southern bank of the river 16.6 miles from the Atlantic Ocean. The main harbour comprises the total width of Savannah River and extends from the Standard Oil Co. terminals, 2.8 miles below the city, to the Atlantic Creosoting Co. terminals, 5.5 miles above the city.

The harbour is connected with Augusta, Georgia, by the Savannah River which is under improvement to a depth of 6-ft. at low water; and with coastal cities to the North and South by the Intracoastal Waterway, which has an authorised depth of 12-ft.

Information regarding channel depths and harbour conditions is given under the subject "Harbour Improvements."

#### Tides

The mean tidal range at the upper end of the harbour is 7.5-ft. and at the lower end about 7-ft.; while the extreme tidal ranges are about 10.5-ft. and 11-ft. respectively.

#### Tidal Currents

The tidal currents between the training walls at the entrance have a mean velocity at the strength of the ebb current of 2.6 knots, and at Savannah the ebb current has a velocity of 2 knots.

\*Extracted and Abridged from Port Series No. 10, prepared and published, 1940, by the War Department, United States Army and the United States Maritime Commission.

The flood current has a velocity of 1.6 knots in the lower part of the river and about 1.4 knots at Savannah. The currents set in the direction of the channel except at the entrance near Tybee Light, where the flood sets North-westward across the channel.

#### Anchorage

The usual anchorage for vessels is in Tybee Roads, about 2 miles Eastward of Tybee Lighthouse and Tybee Island, adjacent to the Bloody Point sailing range. This anchorage is surrounded by shoals which lie off the entrance to Calibogue Sound and Savannah River, and can be entered either in the daytime or at night. The holding ground is good and the depth ranges from 17 to 27-ft. There is also an anchorage outside the bar near Tybee gas and whistling buoy with good holding ground and greater depth. Vessels rarely anchor in the river, as there is no room for large vessels to swing; but the mooring dolphins just above the mouth of the South Channel and about 4 miles below Savannah, may be used.

#### Weather Conditions

Open Season for Navigation.—The channels in the harbour of Savannah are navigable throughout the year.

Prevailing Winds.—The prevailing winds are South-westerly, but during the winter months they are Northerly and Westerly. No monsoon winds occur at this port. Regional storms, tropical, occur in July, August, September and October, being most frequent during August and September.

Fogs.—Fog is most prevalent from November to March.

Precipitation.—The mean annual precipitation computed from the Weather Bureau records for 69 years is 47.51-in.

Temperature.—The daily mean minimum temperature computed from the Weather Bureau records for 66 years is 58.5°, and the daily mean maximum temperature is 75.5°.

## Port of Savannah—continued

### Bridges

The only bridge across the channel is that of the Seaboard Air Line Railway, located about 2 miles above Savannah and 19 miles from the mouth of the river. It is of bascule lift type with four spans. The width of the centre spans is 116-ft. and the lowest point of the structure is 17.93-ft. above mean low water and 10.58-ft. above mean high water. This bridge has no closed period.

### Harbour Improvements by the United States.

Savannah River at and below Savannah, Georgia.—The original project for improvement of this section of the harbour was adopted by Congress May 18th, 1826, and since that date several projects and modifications of projects have been adopted.

The existing project, authorised by the River and Harbour Acts, of June 23rd, 1874; March 2nd, 1907, June 25th, 1910; July 25th, 1912; August 8th, 1917; January 21st, 1927; July 3rd, 1930; and August 30th, 1935, provides for a channel 30-ft. deep and 500-ft. wide from the 30-ft. contour in the ocean to the old quarantine station, a distance of 10.2 miles; thence 30-ft. deep and generally 400-ft. wide to the Seaboard Air Line Railway bridge, a distance of 16 miles; then 26-ft. deep and 300-ft. wide to the foot of Kings Island, 1.3 miles, and then 26-ft. deep and 200-ft. wide to the vicinity of the Atlantic Creosoting Co., 2.1 miles; a total length of 29.6 miles. The project further provides for:

(a) Enlargement of contracted portions of the channel and such enlargements of the channel as may be necessary to smooth out abrupt changes and for otherwise improving the hydraulic conditions with a view to reducing shoaling.

(b) A turning basin near the upper end of the harbour to be formed by widening the 26-ft. channel to 600-ft. for a length of 600-ft. and providing proper approaches.

(c) The maintenance of channels, anchorage basins, enlargements at Drakes Cut, Kings Island, West Broad and Barnard Streets, mooring dolphins near Fort Oglethorpe, and the existing training walls and jetties.

The existing project was completed during 1937. In April, 1940, the controlling dimensions were as follows: For the 30-ft. channel 29-ft. over a width of 175-ft.; and for the 26-ft. channel 24.2-ft. over a width of 125-ft.

The Chief of Engineers recommended in House Document No. 283, Seventy-sixth Congress, first session, that the existing project be modified to provide for widening the present channel in the vicinity of the Atlantic Coast Line Railway terminals from 400-ft. to a maximum of 550-ft. for a length of 5,000-ft., and for deepening the present authorised channels and turning basin above the Seaboard Air Line Railway bridge from 26 to 30-ft. at mean low water, with no change in width.

Savannah River Below Augusta, Georgia.—The original project for the improvement of this section of the harbour was adopted by the River and Harbour Act of March 3rd, 1881.

The existing project, authorised by the River and Harbour Acts of September 19th, 1890; June 25th, 1910; July 3rd, 1930; August 30th, 1935; and August 26th, 1937, provides for a navigable channel 6-ft. deep and 75-ft. wide (at ordinary summer flow, which corresponds to a discharge of 4,000 second-ft. at Augusta, Georgia), from the upper end of Savannah Harbour to the head of navigation at Augusta, 3 miles above Fifth Street Bridge, a distance of approximately 199 miles. The improvement is to be obtained by the construction of one lock and dam at New Savannah Bluff, the use of contraction works, the closure of cut-offs, bank protection, removal of snags, overhanging trees, and wrecks, and the dredging of troublesome bars. The mean tidal variation at the mouth of the river is 6.9-ft. The freshet variation above the low-water plane of reference at the head of the improvement is approximately 18-ft. ordinarily, with an extreme of 39-ft. During the calendar year 1939 the controlling depth was 6.3-ft. or greater for 74 per cent of the time.

The Chief of Engineers in Senate Document No. 66, Seventy-sixth Congress, first session, recommended that the existing project be modified so as to provide for construction of the Clark Hill Reservoir for the regulation of stream flow in the interest of navigation and for the development of hydroelectric power.

Intracoastal Waterway Between Beaufort, S.C., and St. John's River, Florida. (Beaufort S.C., to Cumberland Sound Section).—The existing project was modified by the River and Harbour Acts of August 25th, 1937 and June 20th, 1938, to provide for deepening the main route of the waterway from 7-ft. to 12-ft., at mean low water, for widths of 90 to 150-ft. The project also provides at some localities alternate and protected routes 5 to 8-ft. deep at mean low water, and for an anchorage basin at Thunderbolt, Georgia.

The section of the waterway between Beaufort, S.C. and Savannah, Georgia, was deepened to 12-ft. during 1939. Work was commenced during May, 1940, on dredging to 12-ft. that section of the waterway between Savannah, Georgia, and Fernandina, Florida, and the work has since been completed.

### Public Terminal Improvements

The City of Savannah owns and operates several wharves. Principal among these is the municipal dock, which is an open wharf extending 727-ft. from the foot of Bull Street to the foot of Abercorn Street, and providing about 23,000 sq. ft. of wharf space.

Other water-front docks owned by the city are situated at the following street ends: East Broad, 100-ft.; Lincoln, 51-ft.; Bull, 75-ft.; Barnard, 75-ft.; West Broad, 45-ft. Some of this property has been leased to private parties.

### Ownership of Water Front

The extent of the improved water front on the North side of the Savannah River (Hutchinson and Fig Islands) is about 5,000-ft. Of this total the United States owns about 600-ft. and the Seaboard Air Line Railway about 4,400-ft., 500-ft. of which is leased to the Gulf Oil Corporation and 300-ft. to Southern Fertilizer and Chemical Co. Of the undeveloped deep-water frontage on the North side of the river, the City of Savannah owns approximately 3,100-ft. and the Seaboard Air Line Railway about 3,600-ft. The remainder is owned by various companies and private individuals.

The distance by river between the lower and upper limits of the improved water front on the South side of the river is about 8 miles. Of this total, the Atlantic Coast Line Railroad owns about 8,800-ft. of frontage, of which approximately 5,100-ft. are developed. The Central of Georgia Railway with its subsidiary, the Ocean Steamship Co., owns about 5,250-ft. of developed frontage, a portion of which is under lease to the Merchants and Miners Transportation Co. The Union Bag and Paper Corporation owns 2,500-ft. of developed frontage and the Savannah Warehouse and Compress Co. owns 4,300-ft.

The City of Savannah owns 575-ft. of improved frontage on the South side of the river, situated at street ends, and 727-ft. frontage, known as the municipal dock, located between Bull and Abercorn Streets, opposite Slip No. 3 of the Seaboard Air Line Railway terminals. Unimproved property owned by the city includes: Deptford track, comprising 1,600 acres of undeveloped property which has a water frontage extending 7,000-ft. down river from the property of the Standard Oil Co.; the site of the Terry Co.'s old dry dock, above the Pure Oil terminal, with a frontage of 1,500-ft.; and old Oglethorpe on the South bank opposite the mouth of Back River, having a frontage of about 250-ft.

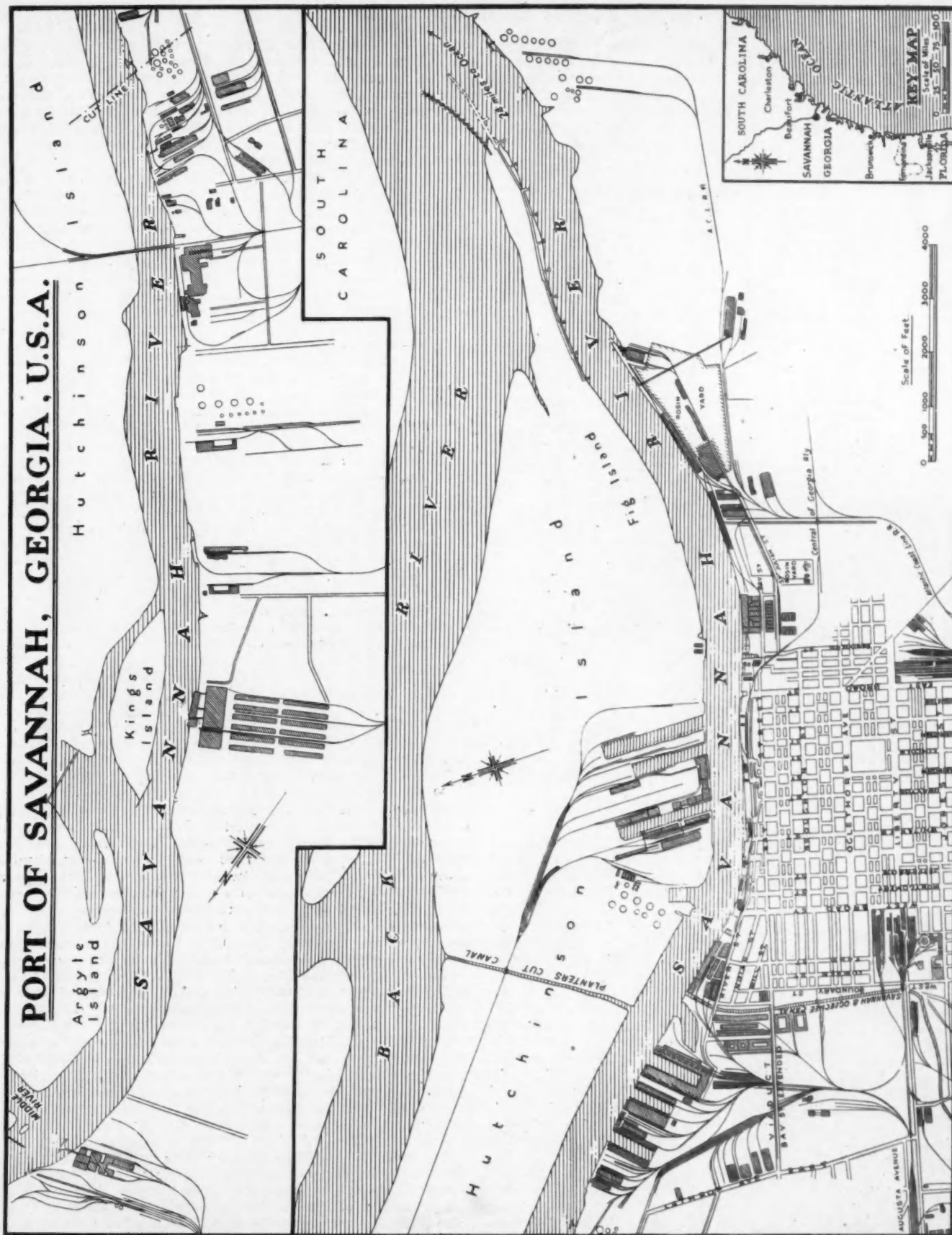
The balance of the water front on the South side of the Savannah River is owned by private individuals and companies.

### Coal Bunkering

There are three companies at the Port of Savannah with facilities for bunkering coal. Coal may be delivered over the wharves at the rate of 30 to 55 tons per hour or by lighter and derrick barge at ship's berth at the rate of 50 to 75 tons per hour.

### Oil Bunkering

Fuel oil for bunkers may be obtained over the wharves of four companies at Savannah. Depths alongside these wharves range from 26 to 30-ft., and bunkering capacity at the wharves varies from 300 to 1,500 barrels per hour.



### Port of Savannah—continued

In addition, two of these companies have equipment for bunkering vessels at ship's side. The Gulf Oil Corporation operates a 5,000-barrel capacity barge with a bunkering capacity of from 800 to 1,000 barrels per hour; and the Colonial Bunker Oil Co. operates a 4,200-barrel capacity barge which bunkers at the rate of 1,000 barrels per hour.

The price of bunker oil is subject to fluctuation but is usually 5 cents less than New York posted price.

#### Port and Harbour Facilities

There are 49 piers and wharves at Savannah with depths of water alongside ranging from 4 to 30-ft. at mean low water, 6 of which are on the North side of the river and 43 on the South side. Seven piers and wharves are operated by railroad companies, 4 by regular coastwise and local steamship lines, 5 by oil companies, 2 by coal companies, 3 by fertilizer companies, 2 by a cotton warehouse company, and 7 private wharves are operated by various industries for miscellaneous purposes. Nine wharves are used as tie-ups for floating equipment, 3 of which are operated in connection with marine railways, 2 by towboat companies, 1 by a marine contractor, 1 by a lighterage company, and 2 by the United States Engineer Department. Besides the large municipal dock, the city maintains landings at 5 street ends for small craft. Four wharves are not operated regularly but are occasionally used for berthing purposes.

The majority of the piers and wharves are of timber pile construction with timber decks. Several of the city properties are of earth fill behind concrete, masonry or timber bulkheads. The Ocean Steamship Co.'s piers are of concrete on concrete and timber piling and that of the Merchants and Miners Transportation Co. is of solid fill behind a concrete bulkhead constructed on wood piles. Steel sheet piling is used in the construction of the wharves of the United States Engineer Department and the Gulf Oil Corporation on the North (Hutchinson Island) side of the river and those of the Union Bag and Paper Corporation, the Mexican Petroleum Corporation, and the National Gypsum Co. on the South side. The Union Bag and Paper Corporation has a steel bulkhead of 750-ft., a wood bulkhead of 200-ft., and a timber pile and timber deck wharf of 720-ft. A part timber and part concrete deck runs the entire length of the bulkheads, making this the largest private wharf in the harbour, with a total length of 1,670-ft.

Seventy per cent. of the wharves are served by direct connections with the various railroads at the port.

#### Railway and Steamship Terminals

The principal piers and wharves at Savannah are owned and operated by the Atlantic Coast Line Railroad, the Central of Georgia Railway, and the Seaboard Air Line Railway.

The Atlantic Coast Line Railroad terminal is located on the South shore of the river about a mile below the centre of the city. It extends a distance of approximately 5,805-ft. East of Commerce Street and provides berthing space of about the same amount with depths ranging from 12 to 30-ft. at mean low water. The principal commodities handled are naval stores, cotton, lumber, and fertilizer materials. Ample covered space is provided for the storage of cotton and fertilizers and a considerable acreage of open storage is available for naval stores. In addition to the traffic of its own lines, the Atlantic Coast Line handles the naval stores business of all of the other railroads at the port. Rosin and spirits barrels are handled from car to storage and from storage to shipside by hand rolling or by means of electric trucks or tractor-drawn trailers having a capacity of 5 barrels each. Naval stores for shipment are handled to the wharf and loaded by ship's tackle or are placed on lighters for movement to foreign and coastwise ships docked at other terminals. Cotton is transferred to shipside or lighters by hand trucks.

The Southern States Phosphate and Fertilizer Co. leases a portion of the wharf, on which is situated an overhead runway extending to the plant, about 600 yards from the water front. Electrically operated 1½-ton dump cars receive the materials from the ship's hold and transport it to the plant for mixing. Other portions of the terminal property are under lease to the South-

eastern Compress and Warehouse Co., the Howden Coal and Oil Co., Columbia Naval Stores, and Whitney and Oettler (naval stores). The South-eastern Compress and Warehouse Co. occupies a wharf space of 705-ft. and operates a cotton compress and storage business which is known as its East Side plant. The coal company, in addition to operating a retail domestic trade, conducts a coal bunkering service along a leased wharf space of 300-ft. at the west end of the terminal.

The Central of Georgia Railway and its subsidiary, the Ocean Steamship Co. of Savannah, jointly occupy extensive terminals on the city side of the river between Water Street and Lathrop Avenue East. Three slips, 185 and 225-ft. in width and from 853 to 1,020-ft. long, are provided for coastwise and foreign vessels. These facilities provide approximately 8,000 lin. ft. of berthing space with depths averaging 26-ft. at mean low water.

The Ocean Steamship Co. terminal, which is included in this unit, consists of two concrete and steel freight and passenger transit sheds on either side of a slip 1,020-ft. in length, connected by a two-storey head house in which are located the offices of the terminal and its passenger facilities. The shed on the East side of the slip is used exclusively for the receipt of cargo discharged from the company's regular line steamers from Boston and New York. The cargo is transferred directly to freight cars in the shed for dispatch to the interior or to the city platform for local delivery. Unloading is done by hand labour and electric storage-battery trucks are used in the distribution of the freight to cars. After discharging cargo, the steamer is shifted to its regular berth alongside the loading shed on the West side of the slip, where it receives cargo for Boston or New York. Loading is done by hand labour directly from accumulated cargo or from cars spotted on delivery tracks within the shed. A small portion of the outward cargo of these ships, principally naval stores, is lightered to the terminal and placed on board from the water side.

The railway has three fertilizer warehouses, Nos. 9 and 10 paralleling shed O on the wharf West of slip No. 3 and No. 15 lying between transit sheds M and N on the wharf East of slip No. 3. Bulk fertilizer material going into warehouses Nos. 9 and 15 is removed from the hold of a vessel by ship's tackle, deposited in movable steel hoppers on the dock, and discharged into electric dump trucks of 1½ tons capacity. The trucks in turn dump the material into ground-level hoppers, three of which are located at the water end of each warehouse. Endless chain bucket conveyors raise the material to cars running on elevated tracks the length of each warehouse, from which it is dumped automatically to piles on the floor at any desired point. Each of these two warehouses is equipped with three such units.

The other wharves of the Central of Georgia Railway are used principally for handling cotton and general commodities in connection with foreign and coastwise commerce. Extensive storage space and transit areas are available within easy access of the water front. Numerous electric trucks of 2-ton capacity are used for the transfer of cotton and miscellaneous freight to and from shipside and various points within the terminal.

The Merchants and Miners Transportation Co. leases a terminal from the Ocean Steamship Co. at the foot of Fahm Street, from which it operates a coastwise freight and passenger service to Baltimore, Philadelphia and Jacksonville. The wharf, which has a berthing space of 1,110-ft. with a depth alongside of 26-ft. at mean low water, is covered and provides a transit shed area of about 138,750 sq. ft. Railroad tracks which can accommodate about 90 cars are located at the rear of the transit shed. Facilities for short-time storage are available at the delivery depot of the company situated in the rear of the transit shed. All freight is unloaded from side ports by hand trucks. Cargo is loaded by hand truck from the transit shed and occasionally the ships receive naval stores and cotton as part of their outward cargo from lighters alongside.

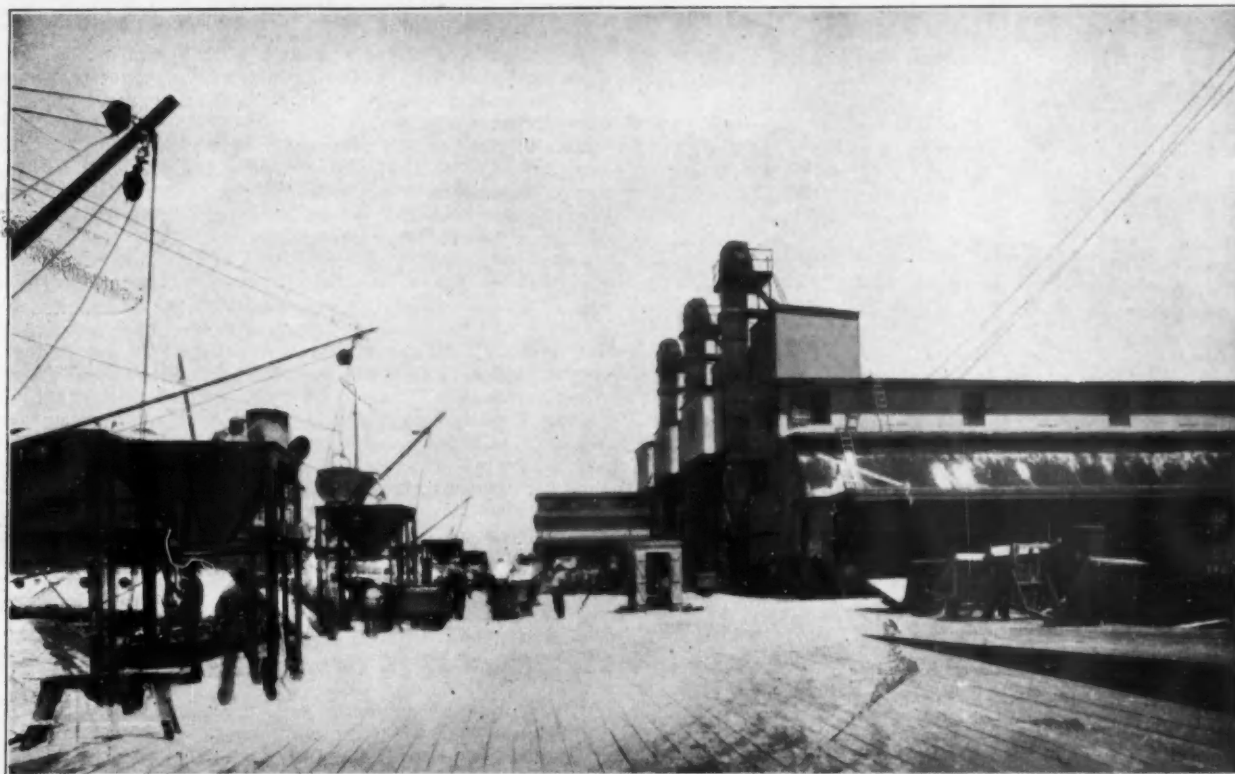
The Seaboard Air Line Railway piers, which are located on Hutchinson Island, just opposite the business district of the city, constitute the largest terminal unit at the port. There are two slips each 200-ft. wide, one 600 and the other 1,800-ft. in length; also three piers with approximately 5,200-ft. lin. of berthing space, with depths alongside ranging from 23 to 30-ft. at mean low water.

*Port of Savannah—continued*

Facilities formerly used for the storage of cotton and cotton products, naval stores, fertilizer, and lumber, which at one time were taxed to capacity, have been more than ample to serve the demands on the terminal in recent years. There are no special mechanical handling facilities, ship's tackle being used almost entirely for handling cargo freight received for local delivery is cleared through the warehouses on Pier 3 and transferred by rail to the company's delivery shed on Louisville Road, in the city proper. Miscellaneous outward freight of local origin is either assembled at this shed and transferred by rail or is lightered directly from various wharves to the terminals for shipment. The terminal can accommodate approximately 600 cars on house

capacity and is available for assistance from the river at all times.

A portion of the space immediately West of Pier No. 4 is under lease to the Southern Fertilizer and Chemical Co., which operates one of the largest mixing plants in the South. Fertilizer materials are handled direct from shipside to the plant by electric dump cars which operate on two overhead runways extending from the plant to the face of the slip on Pier No. 4. The Gulf Refining Co. also leases space on the terminal located about 1,500-ft. West of Pier No. 4, on which they maintain several large storage tanks together with warehouse facilities and facilities for handling their products by both rail and water. The American Warehouse and Storage Co. leases and operates four warehouses on Pier No. 4,



Unloading Nitrate of Soda at Central of Georgia Railway Fertilizer Wharf, showing Three Bucket Elevators at end of Warehouse.

tracks, sidings, and in the storage yard. Communication with the mainland is effected by means of the company's bridge which spans the Savannah River about 2 miles above the centre of the city. Regular ferry service connects all island property with the foot of Bull Street and is maintained gratuitously by the company for the transfer of its employees and others to and from the terminals.

The terminal's drinking and domestic water supply is furnished by artesian wells on the island. Current for lighting and power is obtained from the Savannah Electric and Power Co., which maintains separate sources of supply from Savannah to the island through two separate cables under the river.

The terminals cannot be reached by the city fire department's equipment and are dependent upon the company's own equipment, using the Savannah fire department's man-power if necessary. An automatic electric fire pump in the power house on Pier No. 2, with a capacity of 1,500 gallons per minute, together with a 1,000-gallons per minute electric pump on Pier No. 4, can furnish a total of 2,500 gallons per minute, pumping directly from the river or slip into high-pressure fire lines with conveniently located hydrants and also into a 100,000-gallon steel storage tank on a high tower. An efficient electric fire alarm box system is maintained, also ample hose, hose reels, fire barrels and buckets, and other fire protection facilities. The company's ferry boat is equipped with a fire pump of 750 gallons per minute

and also space in several warehouses on Pier No. 3 for the receipt and storage of bulk and bagged fertilizer materials and general cargo. Movable hoppers are used in connection with hand carts for the discharge of bulk materials from ships and hand trucks are used for handling bagged materials.

Since 1935, the unused sheds on Pier No. 1 have been demolished, leaving Piers Nos. 1 and 2 entirely open. A number of cotton sheds and warehouses on Pier No. 3 have also been removed, leaving large areas on these three piers suitable for future development. A dock with a marginal track is maintained on the upper side of Pier No. 2, extending 650-ft. along Slip No. 2. Slip No. 1, formerly 200-ft. wide and approximately 1,980-ft. long, and also about 740 ft. of slip No. 2 are not in service, but could readily be redredged to their former sizes and depths should the shore facilities again develop.

The Savannah and Atlanta Railway while operating no terminal of its own, does serve exclusively five of the principal industries along the upper reaches of the port. Two of these, the Mexican Petroleum Corporation of Georgia and the National Gypsum Co., are located on terminal sites obtained from the Foundation Co., a wholly owned subsidiary of the Savannah and Atlanta Railway. The gypsum dock is equipped with modern electric machinery consisting of a movable unloading tower with a 2½-ton bucket, endless belt conveyors, and a stacker moving on tracks. Material can be conveyed to storage piles by this equipment or loaded

### Port of Savannah—continued

directly into cars on a rail siding in the rear of the tower tracks. The other three facilities served by the railway are located upon developments of the Port Wentworth Corporation and consist of the Savannah Sugar Refining Corporation and Atlantic Creosoting Co., and the Savannah River Lumber Corporation. A total of 18½ miles of track is operated by the Savannah and Atlanta Railway in serving these five facilities.

The Beaufort and Savannah Line terminal is located on the South bank of the river between Abercorn and Lincoln Streets. The wharf provides 308 lin. ft. of berthing space with depths of 6 to 8-ft. alongside at mean low water, but the entire length is not leased by the boat line as the owner retains the West end for his own use. A transit and passenger shed with 7,500 sq. ft. of floor area occupies the East end of the wharf and is served by the marginal tracks of the Central of Georgia Railway.

**Municipal Wharves.**—The principal wharf property belonging to the city is known as the Municipal Dock and consists of a public wharf extending from the foot of Bull Street to the foot of Abercorn Street, a length of 727-ft. Depths at mean low water along the face of the wharf range from 16 to 18-ft. It is an open shore wharf with a wood deck of varying widths supported on wood piles, and is used principally as a base for the United States Coastguard cutter *Tallapoosa* and for smaller boats of the United States Customs and Quarantine Services. The Customs Service maintains a small office on the East end of the wharf. At the West end, the bulkheaded foot of Bull Street sets back from the wharf line forming a slip in which a floating dock with a ramp to the shore, is secured. It is a free landing, open to the general public, but it is used almost exclusively by the Seaboard Air Line's ferry to its Hutchinson Island terminals, which lie opposite. The city maintains public facilities at several street ends near the business district for the general use of launches and other small craft. These properties are open to public use and no dockage charges are assessed. The foot of West Broad Street is used as a landing by the small launch of the Gulf Refining Co., which serves as a ferry to the company's plant on Hutchinson Island.

**Private Wharves.**—The seven wharves used exclusively by private enterprises are owned and operated as follows: The Savannah Electric and Power Co., for the receipt of fuel oil; the Pierpont Manufacturing Co., producers of wood products such as boxes, splint baskets, etc.; the Union Bag and Paper Corporation,

for the receipt of pulpwood and chemicals; the National Gypsum Co., for the receipt of gypsum rock and other bulk materials; the Savannah Sugar Refining Corporation, for the receipt of raw sugar, chiefly from Cuba; the Atlantic Creosoting Co., for the receipt of timber and creosote oil and the shipment of creosoted timber; and the Savannah River Lumber Co., for the receipt of logging equipment and supplies. While the privilege of general use of these facilities is not extended to the public, permission to tie up at most of the wharves can usually be obtained from the owners in cases of necessity.

**Government Wharves.**—The United States Army Engineer Department maintains a wharf and yard on Hutchinson Island below the Seaboard Air Line terminals, for the service and repair of its dredgers and other floating equipment. Another wharf owned by the Engineer Department is located just West of the foot of Bull Street, where inspection and supply boats can berth. A warehouse equipped with refrigerator facilities in connection with this wharf is used as a supply base for food and galley equipment for the dredges.

As mentioned under municipal wharves, the United State Coastguard cutter *Tallapoosa* is operated from a leased berth at the municipal dock. The United States Customs Service revenue cutters and the United States Public Health Service boats also operate from the municipal dock.

**Fire Protection.** The water front of the Port of Savannah is protected by a well-equipped city fire department. All piers on the South side of the river can be reached by this equipment. In addition, five tugs and one water barge equipped with fire pumps and hose are available and can reach any pier in the harbour. All warehouses in active use are equipped with sprinkler systems covering all cargo space and there are sufficient fire hydrants, equipped with hose, to protect all wharves and warehouses. Wharves and piers within the city limits have tie-ins with the city water mains, and those outside the limits of the city have their own water systems of storage tanks and hydrants supported by steam and/or electric pumps, with river intakes. In addition to the above, all of the principal piers and wharves are equipped with electric alarm systems, water barrels and buckets, and chemical extinguishers, and are patrolled by watchmen.

(To be continued)

### Bluff Harbour Board, New Zealand

#### Excerpts from Chairman's Annual Address

Mr. W. J. A. McGregor, Chairman of the Bluff Harbour Board, New Zealand, has reported on the operations of the Board for the year ended 30th September, 1941.

**Income and Expenditure.**—Summarised, this account shows the following:—

	£
Income ... ..	38,955
Ordinary Expenditure ... ..	38,519
	436
Less Depreciation ... ..	8,076
Nett Loss, being debit balance on the year's working ... ..	7,640

Last year the nett loss on the year's working was £6,626.

**The Board's Financial Position.**—Since 1937 a surplus of Cash Assets over Loan Indebtedness and Cash Liabilities has replaced what was known as the nett debt of the Board. At 30th September, 1941, this surplus stood at £6,469 as against £5,910 in 1940. This is an increase of £559.

The annual loan charges, interest and Sinking Fund payments amounted to 7.46% of the total revenue.

It has been customary for the Chairman to give particulars of the trade of the Port and the shipping handled for the twelve months together with a comparison with other ports in New

Zealand, but instructions have been received to withhold all this information until after the war.

**Obituary.**—I regret to record, just after the close of the year under review, the death of Mr. C. S. Longuet, who rendered conscientious and faithful service as a member of this Board from 1911 until 1939, serving as Chairman for two years from 1925 to 1927.

#### Cargo-handling on the Clyde.

Returns for the first five months of the present year, issued by the Regional Port Director, show that there has been increasing improvement in the work done by dock workers on Clydeside. The figures for the highest rates of discharge are as follows:—

January, 8,746 tons in 8½ days, equivalent to 1,005 tons per day.  
February, 6,375 tons in 4½ days, equivalent to 1,417 tons per day.  
March, 8,473 tons in 6½ days, equivalent to 1,303 tons per day.  
April, 6,467 tons in 4 days, equivalent to 1,616 tons per day.  
May, 8,943 tons in 5½ days, equivalent to 1,626 tons per day.

The Regional Port Director has officially complimented the men on these achievements, which have been facilitated by the complete overhaul of the mechanical equipment of the several ports. There has been some infiltration of women into the industry, some of them acting as crane operators, but the proportion is necessarily small and the vast bulk of the work has been, and is being, done by the regular dockers.

The fact that goods made of raw materials in short supply owing to war conditions are advertised in this Journal should not be taken as an indication that they are necessarily available for export.

# Destruction of Timber by Marine Organisms in the Port of Sydney

## Excerpts from Supplementary Report No. 2

By Messrs. R. A. JOHNSON and F. A. McNEILL.

(Continued from page 57)

### The Effect of Marine Growth on the Lodgment of "Cobra" Larvæ and Subsequent Destruction of Timber by "Cobra."

The special investigation carried out at The Spit test station involved two separate sets of tests. One was initiated at a time of the year when *Cobra* larvæ were abundant in the area; the other when only sparse *Cobra* larvæ were present. The former traversed a period of decreasing numbers of larvæ, while the latter dealt with a gradually increasing phase of larval activity. Necessary data governing the tests were secured from the observations recorded in the Annual Cycle of Attack investigations.

#### Test Station No. 31—The Spit, Middle Harbour, Port Jackson.

##### First Series Test.

Two oregon fir control test samples immersed 18th February, 1936. *Cobra* larvæ initially abundant and decreasing during progress of test.

Sample "A" was kept under observation over an immersion period of five months. As nearly as possible it was removed from the water for inspection at regular monthly intervals and the accumulated marine growth completely removed without damage to the timber surface.

Sample "B" underwent a similar period of immersion to Sample A, and was examined on the same inspection days. All marine growth, however, was left to accumulate or otherwise behave in a natural manner.

##### Sample A.

(Cleaned of growth at each inspection).

Inspection date: 22nd March, 1936.

Water temperature: 71° Fahr.

Abnormally heavy hydroids (*Plumularia*), with an underlying growth of scattered barnacles extending to within 6-in. of the upper end.

Barnacles measured  $\frac{1}{4}$ -in. across their basal plates.

Inspection date: 25th April, 1936.

Water temperature: 65° Fahr.

Very heavy hydroids (*Plumularia*), covering surfaces of sample.

##### Sample B.

(Growth left undisturbed).

Abnormally heavy hydroids (*Plumularia*), with a few barnacles near the upper end.

Abnormally heavy hydroids (*Plumularia*), still present, with addition of some patches of young, soft, simple tunicates.

Barnacles extended over sample for 18-in. from the upper end.

(May Inspection missed).

Inspection date: 24th June, 1936.

Water temperature: 57° Fahr.

Heavy hydroids (*Plumularia*), covering only upper half of sample, with patches scattered over the lower half.

Previous abnormally heavy growth of hydroids (*Plumularia*), displaced by an abnormally heavy growth of soft, simple tunicates.

Barnacles as before.

Inspection date: 22nd July, 1936.

Water temperature: 58° Fahr.

Only very light growth of hydroids (*Plumularia*) present.

Only heavy growth of hydroids (*Plumularia*) present.

Barnacles as before.

Previous growth of soft, simple tunicates had fallen away.

Inspection date: 20th August, 1936.

Water temperature: 59° Fahr.

Practically no growth present; less than at previous inspection, and only hydroids (*Plumularia*).

Sample partially dissected for borer examination.

Timber 60% destroyed by *Cobra*, five months after immersion.

No change in growth.

Sample partially dissected for borer examination.

Timber 40% destroyed by *Cobra*, five months after immersion.

(September Inspection missed).

Inspection date: 20th October, 1936.

Water temperature: 60° Fahr.

##### Sample A.

(Cleaned of growth at each inspection).

Sample finally dissected.

Timber had reached the 100% stage of *Cobra* borer destruction.

##### Sample B.

(Growth left undisturbed).

Sample finally dissected.

Timber 75% destroyed by *Cobra*.

#### 2nd Series Test.

Two oregon fir control test samples immersed 18th September, 1936. *Cobra* larvæ initially sparse and increasing during progress of test.

As previously, two control test samples (A and B) were kept under observation, the same treatment being accorded each as outlined for the 1st Series Test. In the present case an immersion period of eleven (11) months was covered.

##### Sample A.

(Cleaned of growth at each inspection).

Inspection date: 16th October, 1936.

Water temperature: 60° Fahr.

No growth.

Very light general growth.

Inspection date: 23rd November, 1936.

Water temperature: 67° Fahr.

Heavy growth of barnacles and branching Bryozoa (*Bugula*).

Barnacles measured up to  $\frac{1}{4}$ -in. in diameter and represented a surprising growth rate; growth heaviest in middle-third section of sample.

Heavy growth of barnacles and branching Bryozoa (*Bugula*), as with Sample A; other details similar.

**Destruction of Timber by Marine Organisms—continued**

Inspection date: 20th December, 1936.

Water temperature: 74° Fahr.

Light growth of barnacles and branching Bryozoa (*Bugula*).

Very heavy growth of barnacles, branching Bryozoa (*Bugula*) and small mussels on lower half of sample; upper half of sample with similar varieties of growth, but only of a light nature.

(January Inspection missed).

**Sample A.**

(Cleaned of growth at each inspection).

**Sample B.**

(Growth left undisturbed).

Inspection date: 22nd February, 1937.

Water temperature not taken.

Heavy growth of barnacles, completely covering sample.

Abnormally heavy growth, consisting mainly of small mussels, completely covering the barnacle and Bryozoa growth previously recorded.

Inspection date, 20th March, 1937.

Water temperature: 75° Fahr.

Medium growth of barnacles and brittle calcareous worm tubes.

Degree and nature of growth unchanged from previous inspection, except for more matured state of mussels.

Inspection date: 20th April, 1937.

Water temperature: 68° Fahr.

Light growth of small barnacles.

**A cross-sectional lower end inspection cut disclosed 20% destruction by "Cobra" borers.**

The condition of attack had remained unchanged since 22nd February, 1937, inspection, when the first cross-sectional saw cut was made.

Previously abnormally heavy growth found to have been stripped from sample, apparently by unauthorised persons; only a light growth of barnacles present.

**A cross-sectional lower end cut disclosed only a medium attack by "Cobra" borers.**

(May Inspection missed).

Inspection date: 16th June, 1937.

Water temperature: 58° Fahr.

Medium general growth.

**A cross-sectional lower end cut showed 70% "Cobra" borer destruction.**

Very heavy growth, mainly brittle calcareous worm tubes, covering an underlying cloak of barnacles.

**A cross-sectional lower end cut showed no advance in "Cobra" borer destruction.**

Inspection date: 22nd July, 1937.

Water temperature: 58° Fahr.

No growth present.

**A cross-sectional lower end cut disclosed 90% "Cobra" borer destruction.**

Degree and nature of growth unchanged.

**A cross-sectional lower end cut disclosed a heavy stage of "Cobra" borer destruction.**

**Sample A.**

(Cleaned of growth at each inspection).

**Sample B.**

(Growth left undisturbed).

Inspection date: 20th August, 1937.

Water temperature: 57° Fahr.

Very light general growth.

**Sample dissected for examination and 100% stage of "Cobra" borer destruction recorded.**

Very heavy growth, mainly brittle calcareous worm tubes, thickly covering the underlying barnacles previously recorded.

**Sample dissected for "Cobra" borer examination and the very heavy stage of destruction disclosed.**

Destruction of Turpentine piling by "Limnoria" midway between low tide mark and "mud line"—Walsh Bay.

Illustrated is one of the examples of most advanced destruction which caused a decision to renew the pile. Period of immersion was twenty-two years. The external view is of two attacks located in and around adjacent limb scars, with the dividing partition broken through near the surface. "1" is the end-view of the cross section at "A," "2" is the end-view of the cross section at "B."

**Deductions to be drawn from the Completed Tests**

Both tests proved that the undisturbed marine growth retarded larval *Cobra* infestation, with a consequent effect on the development of borer destruction.

The conclusive evidence of the preventive qualities of marine growth is provided by the results deliberately obtained during periods of the year characterised by opposite conditions of larval distribution in the locality where the tests were made. These

### Destruction of Timber by Marine Organisms—continued

periods were determined by the results of the previously conducted Annual Cycle of Attack observations at Station No. 31 (The Spit).

The 1st Series Test was initiated towards the end of the seasonal period of an abundance of larvæ, the numbers of which were decreasing throughout the duration of the experiment. On the other hand, the 2nd Series Test began when the number of larvæ in the water was reduced to its lowest ebb, following the winter season, so that the quantity of larvæ was increased to its peak total during the experiment.

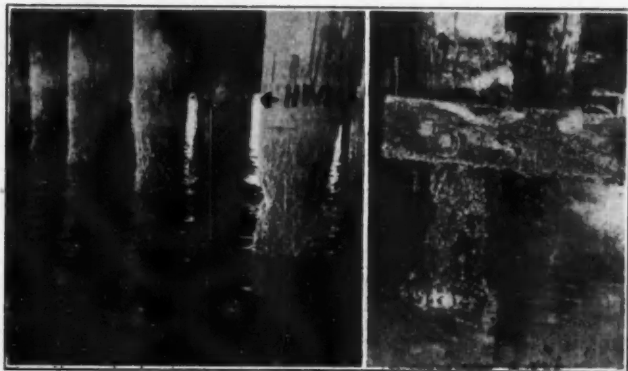
In development of the question it must be accepted that two new control test samples, placed in position together at a time of the year when it was proved by the Annual Cycle of Attack results (see diagrams), that *Cobra* larvæ were abundant in the locality, would equal initial infestation. Therefore, in the first month of their immersion the paired samples of each test series were on equal terms regarding vulnerability of attack. This condition did not apply in the months following the first and subsequent inspections, because the complete removal of marine growth from Sample "A" in each test series allowed further opportunities for larval lodgment on the surfaces of the control test samples thus uncovered.

In the 1st Series Test, over a period of gradually decreasing larval activity, growth protection amounted to 25% in the destruction totals.

Results from the 2nd Series Test, traversing a period of increasing larval abundance, showed that the protection afforded by marine growth amounted to 85%.

The outcome of the tests appears encouraging at first glance. Benefits to be derived from the protective value of marine growths, however, must not be over-estimated, even in areas where growths are known to occur abundantly. Any lasting benefit in the direction of growth protection against *Cobra* borer attack is dependent upon permanent and consistent marine growths, a situation which rarely occurs under natural conditions in a given locality.

Further tests of a like nature to the above are in course of observation. These are concerned with control test samples immersed in the months of November and April, and are expected to provide confirmatory evidence supporting the conclusions already drawn.



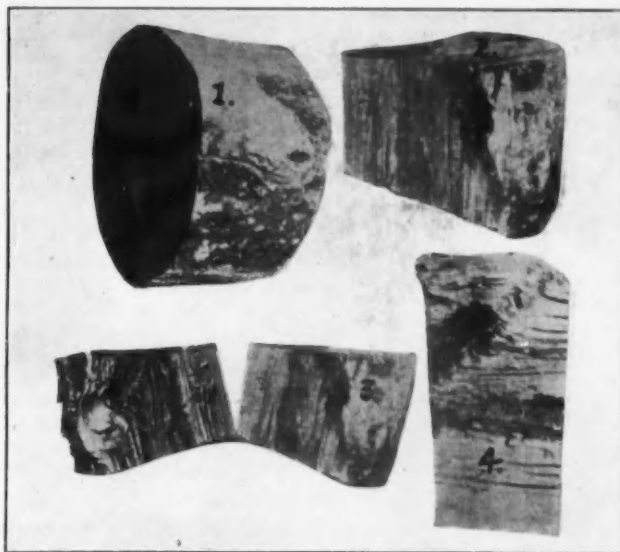
Piling of turpentine showing typical effect of destruction by pill-bugs ("Sphaeroma quoyana" and *S. terebrans*), aided by "Limnoria." The well-marked zone of "Sphaeroma" activity is clearly seen in the levels between tide marks, which are readily accessible for preservation by the Floating Collar Method. At right a more advanced stage of the same kind of attack is seen. In this case the bad position of the waling eliminates the possibility of effective preservation. Photos taken when the tide was about one foot above low water at ordinary spring tides.

#### Resistance of Turpentine (*Syncarpia Laurifolia*)—with special reference to its reaction to "Limnoria" attack below tide levels

The constant reiteration of the claim that turpentine timber holds pride of place in Australia, and most probably the world, as a borer-resistant timber for piling, makes it a duty to record all details of its reaction in local service. In this respect there is the recent history of damage to turpentine piles supporting the jetties over deep water in Walsh Bay, Port Jackson.

Since the inception of systematic marine borer research in the Port of Sydney, every opportunity has been taken to test the

established position of turpentine as a timber of high resistant order. Reputed general weaknesses have been investigated, with the result that they have proved more apparent than real. Now the timber is more than ever believed to have upheld its reputation, particularly in respect to use as piling in deep foreshore water. Proof of this claim (developed below) is provided by the details of the recent investigation.



The potential danger of a flaw in turpentine piling is shown here in the case of a limb scar. In (1) an apparently harmless scar with a blind shallow hole appears on the surface of the sapwood. Split sections (2), (3) and (4) illustrate the direction and penetration of susceptible limb wood, which is connected directly with the corewood of the pile. Such a fault provides easy ingress for the crustacean borer "Limnoria," particularly when it occurs at levels adjacent to low tide mark.

Reviewing the position of turpentine as a resistant timber, it can be said that earlier published reports of the present series have established that no form of *Cobra* other than *Nausitora* has yet been observed which seriously damages sound turpentine in the waters of either the Ports of Sydney or Brisbane, Queensland\*. Fortunately, the voracious *Nausitora* inhabits only far upper river reaches where the salinity of the water is low, but even there it is held in check to a greater degree by turpentine than by any other timber. It is the crustacean borers which have been proved to cause the maximum damage to turpentine piling in the ports mentioned. Their depredations, however, are mostly not of serious consequence, because of the readiness with which effective preventive measures can be applied to the areas where the most intensive attacks occur. In particular reference to the pill-bugs (*Sphaeroma*) it is found that their range of occurrence in the Port of Sydney is confined to a level between high and low water marks. *Limnoria* on the other hand extends its depredations to deeper levels, though with diminished activity. Following is the record of the recent investigation concerning these deeper level attacks by *Limnoria* on turpentine piling:

In October, 1936, the Maritime Services Board administration was gravely perturbed by the collapse of a turpentine pile in deep water beneath a jetty in Walsh Bay, near Test Stations Nos. 3 and 4. The fault occurred in a section limited to a few feet a little above the mud line and the crustacean borer *Limnoria* was the agent responsible. Reference to the published records of the reaction of turpentine test samples at the nearby test station sites showed the established normal high resistance to *Limnoria* attack. In view of this an explanation of abnormal circumstances was sought to meet the case. With the knowledge gained in nine years of close study of local marine borer problems, it appeared quite sound to suggest an inequality in the piling timber fitting

\*In view of the recent discovery of the related bivalve pest, "Martesia," in the high salinity waters of Middle Harbour, Port Jackson, this borer has now to be considered as a potential danger to sound turpentine piling.

### Destruction of Timber by Marine Organisms—continued

the conditions enumerated in the following quotation from the initial report (1932):

"Reverting to the presence of flaws in piles, the matter of careful selection becomes a most important question. Choice of timber should be fastidious if the best and most uniform results are to be obtained. Almost invariably there is one feature which applies to the hundreds of rapidly destroyed piles in Port Jackson [Port of Sydney], and that is the existence of a flaw in the timber. Most dangerous are the scars present in places where limbs have been lopped from the main trunk. Where these occur on a driven pile in a position which will be between the 'mud-line' and high water mark the result is always the same—a direct easy passage for the borers to the heartwood, a means the crustacean pests particularly, turn to immediate advantage. As a result, many apparently sound piles have been found to be quite hollowed out



Evidence of advanced destruction by "Sphaeroma," aided by "Limnoria," in a turpentine pile. In some localities in the Port of Sydney this stage of damage can be reached within fifteen years unless modern preservation treatment is applied. The cross section view at lower left shows the immunity of turpentine truewood to the "Cobra" borers which were abundant in the locality (Long Cove) where the pile was standing.

in the short space of ten years. Such a condition is most dangerous between tide marks, where progress of attack is many times faster than between low water mark and 'mud-line.' The next vulnerable point of attack is an area where a pile has been injured during transit and construction work, especially where 'service' holes have been made and not adequately protected afterwards. Both fastening walings and fenders eventually become loose in all piles, and in these holes attack is rapid. Knots are not serious unless large, although they will be eaten out very quickly by crustacean borers, but if only a couple of inches deep an attack does not proceed. When the malformation caused by a knot enters the heartwood, however, the same damage results as in the case of a limb entrance. The oval holes made by the larvae of longicorn beetles are also to be avoided if numerous, as the 'pill-bug' *Sphaeroma quoyana* immediately occupies and operates in these shelters, where it breeds and rapidly enlarges the cavities.

The value of a special cultivation of trees for piling purposes should here be considered. By such means the supply of timber free from flaws and limbwood in the bole would be a much more simple matter than at present."

The above contentions were founded upon available data on the behaviour of test samples and miscellaneous examples of wharf piles, drawn at irregular intervals in different parts of the Port. Despite the submission of a report to the Board along the same general lines, it considered that it would be a wise precaution to enlist the services of a diver for a thorough examination of the piles in the jetty where the fault had occurred, and also others adjacent thereto. A total of well over a thousand piles thus came under special survey. There was a general belief, not subscribed to by the authors, that the intensity of *Limnoria* attack was much greater below the tidal and near-tidal areas than previously determined. A theory also existed that the intensity of attack as previously determined was being transferred to deeper levels as a consequence of routine eradication measures successfully applied to the tidal and near-tidal areas. To claim such a behaviour for *Limnoria* would, of course, be without biological precedent among the lowly organised forms. It is contrary to the findings of the science of ecology, accounting for exact determination of animal occurrence and habits in circumscribed environments. Thus the evidence from the deep-level examinations could be only remotely connected with the activity of borers concerned with the greater predetermined intensity of attack in the tidal and near-tidal areas.

The diver's critical survey referred to above resulted in the taking of numerous samples from *Limnoria* excavations of various sizes. These were critically examined together with other available data and in the official reports prepared by one of the authors (R. A. Johnson), the following facts were given:

A markedly weak attacking force was present and obviously had diminished to the ineffective stage. The outstanding feature was that the *Limnoria* had destroyed mostly those faults in the timber that were particularly susceptible to their attack. These restricted operations immediately suggested the presence of pre-immersion faults in the piles attacked, as all had been in service for no less a period than twenty years.

An interesting comparison was offered by the evidence of far greater destruction of the same piles near low water level during the same period. In many instances these tidal and near-tidal level attacks were so advanced that repairs and renewals had become essential eight or ten years after the piles had been driven. There was an absence of concerted deep-level destruction, as the piles found to be affected were mostly widely scattered. It would seem that this fact alone reflects adversely on the quality of the timber in those particular cases which, apart from the flaws identified, and of the types previously outlined, could well be the condition described as "Black Turpentine,"<sup>1</sup> an abnormal or diseased state of Red Turpentine.

Because of the unique nature of the piling off the deep foreshores of Walsh Bay, a certain amount of doubt has always existed as to its behaviour. This doubt was accentuated through the necessity for splicing<sup>2</sup> in many cases and prompted an earlier inspection by a diver approximately ten years after the piles had been driven. On that occasion, however, only scattered examples received attention. There was a certain damage located in fault areas as outlined earlier, but the destruction proved to be negligible in extent. It agreed in general with that determined in the recent and more comprehensive inspection, which proved a natural development of the attacks in the predetermined areas of weakness. Therefore it appears that the destruction disclosed by the latest diver's examination was not due to any abnormal borer behaviour such as that earlier referred to.

(To be continued)

<sup>1</sup> Maiden and de Coque, "Turpentine Timber." Report to the Legislative Assembly of New South Wales, 1895. Government Printer, Sydney.

<sup>2</sup> The shortage of single piles of sufficient length, the comparatively great depth of the water and the unusually soft driving to a sound bottom, necessitated the use of two separate pile lengths suliced butt (thick end) to butt. This procedure brought the toe (thin end) of one of the spliced piles uppermost and into the zone of most intensive borer attack, thus exposing to destruction the less resistant section of the pile (usually driven below mud line) which carries more faults such as limb scars.

# Beach Formation by Waves

## Some Model Experiments in a Wave Tank\*

By Major (now Colonel) RALPH ALGER BAGNOLD, M.A.

(Concluded from page 64)

### The Effect of the Presence of Impervious Material at the Crest, Lateral Instability, and the Breakdown of the Upper Beach

As previously described, the original mass of beach material in the tank was heaped against a vertical concrete back-wall. In the course of the experiments, the wave-amplitude was gradually increased during the passage of a long train of waves until the water surging up the rising beach reached the neighbourhood of the exposed wall. That is to say, the vertical plane through the beach crest approached the plane of the wall.



Fig. 15. Breakdown of the Beach when surge reaches the Wall. The Beach angle falls to 14 dogs.

It was found that the crest-line was now no longer stable and horizontal. Either one side of it or the other fell rapidly below the surge-level, and the surplus material accumulated on the opposite side. At the same time the surge-height up the wall on the denuded side rose from  $1.68h$  (for 0.7-centimetre material) to nearly  $2h$ , whilst that on the opposite side remained the same as before. A further slight increase in the wave-amplitude led to a breakdown of the whole beach. The crest-line became stable and horizontal once more, but at a considerably lower level, and was now wholly submerged by each wave. The surplus material went to extend the step to seaward (Fig. 15). The beach angle  $\alpha$  made by the line joining the beach crest to the step had fallen from 22 degrees to 14 degrees.

The presence of the wall had caused a breakdown of the beach to occur before the free water of the surge had been allowed to reach such a height that it actually touched the wall above the shingle. Moreover, careful observation showed that the breakdown was not due to any slipping of the shingle down the wall, or to any internal collapse of the material. Clearly, therefore, it can only have been due to the effect of the wall in preventing the free percolation of water through the material. To test this, an impervious steel plate (the top of which had been roughened by sticking beach pebbles to it) was inserted just below the sloping beach surface (Fig. 16). If this plate had been absent the beach material would have piled up till the crest angle  $\gamma$  reached the angle of repose—33 degrees—and the overall beach angle  $\alpha$  had reached 22 degrees (for the 0.7-centimetre shingle used). The plate was, in fact, found to act in just the same way as the vertical wall had done. Although, again, no internal slipping was detected along the plate-surface and no part of this surface was initially exposed to the free action of the surge, yet the thin layer of material above the plate, instead of increasing in thick-

ness, at once began to be removed by the surge. At the same time lateral instability was again noticed. The plate became denuded at random on one side or the other, and the material began to pile up on the opposite side. When, however, the surge height was slightly raised so that the surge reached the exposed plate-surface on both sides stability again obtained. The now submerged beach-top made an angle  $\alpha$  with the step whose value was exactly the same as that with the vertical wall, that is to say, 14 degrees.

As already stated, this 14-degree beach-angle was that attained by the mature unobstructed beach composed of the 0.05-centimetre material (Fig. 12). Here again, but this time owing to the relative fineness of the interstices between the grains, the porosity of the material was low.

It seems, therefore, from the experimental evidence, that if no water sank into the material the beach angle would remain approximately constant at 14 degrees for a wide range of grain-size and wave-amplitude (for all values of  $R$  up to 400 at least). It should be noted that this statement is subject to the limitation, imposed by the wave-tank, that the motion of the water is in two dimensions only, lateral circulation being negligible. This proviso appears to be fulfilled in nature in the case of shingle beaches of high porosity. The effect on the beach angle of the lateral sweeping movement of the surge over a very flat beach will be discussed later.

### Factors governing the Upper-Beach Profile. The Effects of Energy Losses and of Percolation (two-dimensional water-movement only)

The following ideas as to the behaviour of the upper beach are suggested by the experimental facts.

(1) The surge may be regarded as a special case of a *clapotis*, or standing wave, in process of being reflected off an unyielding wall. The case of the vertical wall has been investigated by Sainflou\*, who found that the surge-heights should be equal to  $2h$  in the case of deep water, and slightly less for water of limited depth.



\*The effect of an impervious layer under the Beach Crest. Instability and Breakdown.

(2) If there are no losses of water energy by friction, internal or external, and no mass loss by percolation through the beach surface during the surge cycle, then the motion of the surge should be reversible, and as much material would always be carried back as was carried forward. Hence there would be no

\*Reproduced by permission from the Journal of the Institution of Civil Engineers, November, 1940.

\*G. Sainflou "Essai sur les Diguees Maritimes Verticales." "Annales des Ponts et Chaussées," vol. 98-ii, 1928, p. 5.

### Beach Formation by Waves—continued

beachward drift of material and the beach angle would be zero. The surge would rise to the height calculated by Sainflou for a vertical wall.

(3) If there are such losses, then the mean drag force of the surge on the surface material is greater on the upstroke than on the downstroke. The excess force is just balanced by the component of gravity in the direction of the now inclined beach.

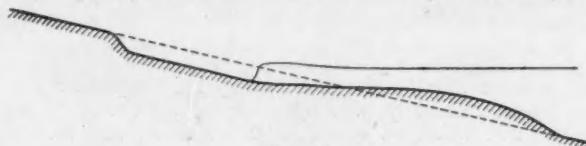


Fig. 17.

The surface angle of the beach at any given contour would, therefore, seem to depend on the ratio of the energy lost or dissipated by the surge over all the beach surface above that contour to the total energy which passed the contour on the upstroke. If this ratio is high, the relatively feeble downward drag of the returning surge cannot carry back a quantity of material equal to that previously brought up, unless the angle is steep and the assisting gravity component large.

The energy losses may be divided into two classes:

- A general dissipation of kinetic energy by friction against the bottom, and a dissipation of the eddy-energy of turbulence by internal fluid-friction;
- Potential energy carried away by the water which percolates into the beach pebbles and does not take part in the return surge.

In the case of fine beach material the porosity is small and the energy-loss (b) by percolation is negligible, so that the inclination of the surface at every level up the beach should be the result of (a) alone. Experiment (Fig. 12), appears to show that the inclination under these conditions is constant; the beach is flat and inclined at 14 degrees.

With material of larger grain-size the loss (b) by percolation is appreciable. Not only is the overall beach angle  $\alpha$  increased, but since the proportional loss of energy by the disappearance of water through the surface is not constant from contour to contour the surface is no longer plane. The proportional loss is greatest at the top, where the mass of the surge-water is nearly zero and where its potential energy is greatest. Here, in the case of pebbles, the entire flow of the water is into, instead of parallel to, the surface, so that all the pebbles which have been thrown up the crest must stay there. The top of the beach therefore piles up until the surface angle reaches the limiting value of 33 degrees. At this angle the pebbles are brought down by gravity alone.

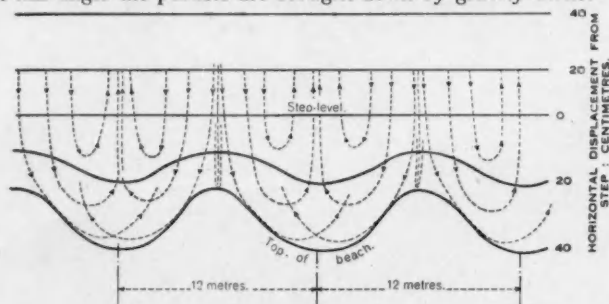


Fig. 19.

Farther down the slope the proportional loss through the surface is smaller, and so the surface angle decreases. At a certain level the net inflow through the surface must be zero. This level is presumably marked by the contour at which the surface inclination is 14 degrees. Lower still there is, as has already been pointed out, an outflow of water; so that the loss of energy by percolation is negative. The outward pressure against the surface pebbles here assists the downward movement of the material, and the surface inclination is, in consequence, less than that of a

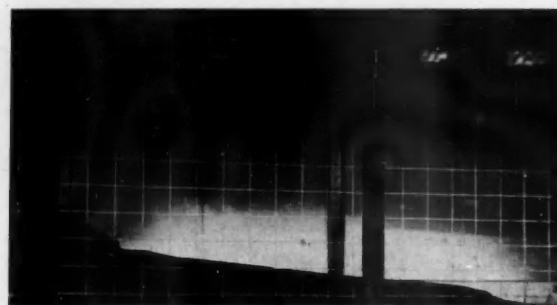
non-porous beach. The inclination of the beach close to the step (the upper step angle) is usually about 12 degrees.

Considering the overall beach angle  $\alpha$  made by the line joining the crest to the step, it seems possible to divide it into two component angles: the "friction angle,"  $\alpha_0$ , which remains approximately constant at 14 degrees for all values of  $R$  up to 400 and perhaps higher, and which is independent of the absolute size of the beach particles; and a "porosity increment,"  $\alpha_p$ , which appears to depend only on the absolute size of the material. The porosity increment varies between zero for fine sand and about 8 degrees for shingle.

(4) That the porosity increment depends only on the absolute size of the grains, and not on the wave-dimension, seems reasonable from the following known facts. The velocity of percolation through material of grain diameter  $d$ , where  $d$  is so small that the flow can be considered to be viscous, is given by:

$$v = \frac{Ag}{L} \cdot \frac{H}{d^2},$$

where  $H$  denotes the head of water,  $L$  the length of the path, and  $v$  the kinematic viscosity of the fluid, which can be taken as 0.01 for water. Since the beach angle remains of the same order for a very large range of wave-amplitudes, the length  $L$  is approximately proportional to the crest height  $s$ , which is itself



A Model Sand Beach showing the Low Beach Angle (5 degs.) due to lateral water movement.

proportional to the wave-amplitude. Furthermore, the mean value of the head  $H$  is also nearly proportional to the wave-amplitude. Hence  $\frac{H}{L}$  is approximately constant, and so for fine material with low porosity:

$$v \propto d^2.$$

For coarse material with high porosity (pebbles), on the other hand, the corresponding expression is:

$$v = B \sqrt{\frac{H}{g}} \cdot \frac{1}{L} d,$$

whence:

$$v \propto \sqrt{d}$$

The porosity therefore increases very rapidly as the material changes from fine sand to pebbles, but varies little throughout the range of beach-shingle sizes.

That the friction angle  $\alpha_0$  is independent of the wave-amplitude can be verified experimentally. The plane beach of Fig. 12, (fine sand) was thrown up by waves of 11 centimetres amplitude ( $R=220$ ). Subsequently the surface was disturbed by a train of short choppy waves of only 1.5 centimetre amplitude ( $R=30$ ). Erosion took place, and the removed material collected farther down to form a step, as shown in Fig. 17. The surface of the excavation was, however, still plane, and it ran exactly parallel to the 14-degree plane of the original beach. (It is worth noting that, since  $R$  was less than 45, no ripples were formed on the lower beach, even though the material was fine sand).

(5) The lateral instability of the beach crest when the surge top reaches the junction between a porous beach and an impervious layer (wall or plate) is easily explained by the percolation

### Beach Formation by Waves—continued

hypothesis. If the free-surface surge reaches the exposed layer before all of it has fallen through the intervening pebbles, a surface backwash is created where there was no backwash before. This backwash removes the uppermost pebbles and so lowers the crest. On the next surge the backwash is greater still, because the impervious layer is exposed and water has surged over it without any loss by percolation. More pebbles are removed, and so on, until the crest is submerged to such an extent that percolation through it is negligible, that is to say, the beach angle becomes that of an impervious beach—14 degrees.

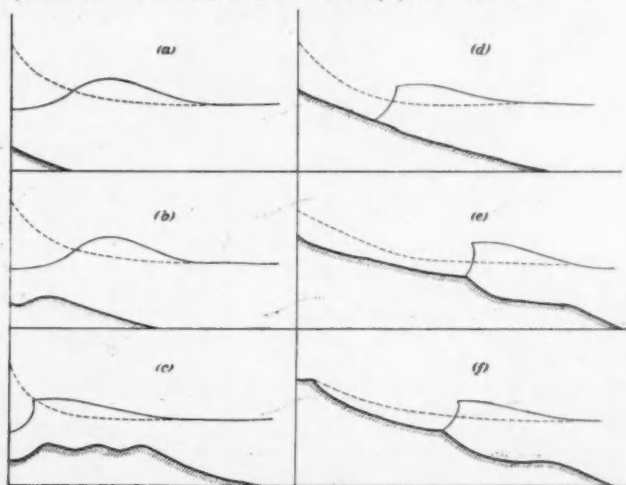
Similarly, if by chance a group of pebbles lodges temporarily at the crest, it causes, locally, a greater separation between the top of the free surge and the impervious layer. Consequently there is increased percolation through the group of pebbles, the return surge is reduced in intensity, and so more pebbles are added to the existing group. The beach therefore builds up at this point.

(6) The effect of porosity on the behaviour of a shingle beach may have interesting applications to the problem of protecting shorelines from sea erosion. For instance, if it is required to induce the maximum possible accumulation of shingle, the presence of an impervious wall appears to be undesirable. It would seem preferable to allow the shingle to pile up against an open palisade of vertical steel bars placed parallel to, and in front of, the sea wall which is to be protected.

#### The Effect of Lateral Water-Movement over Sand Beaches

This Paper has, so far, dealt with experimental beaches formed by surges which move in two dimensions only, that is to say, with those whose lateral velocity at right-angles to the direction of advance of the wave is negligible. In the case of large shingle of high porosity, observation on the seashore shows that when the direction of advance is perpendicular to the shore-line the waves do indeed retain this same direction throughout the rise and fall of the surge. Experimental shingle beaches thrown up within the narrow confines of the wave tank appear, for this reason, to imitate very closely the profiles of real shingle beaches in nature.

When, however, attempts are made to imitate in the tank the formation of sand beaches, the correspondence between the artificial and the natural beaches is not so close. The 14-degree beach thrown up in the tank (Fig. 12), is considerably steeper than most sand beaches found in nature. The reason for this discrepancy is suggested by two interesting observations, one (a), in the wave tank, and the other (b), in nature.



Figs. 20.

(a) Fig. 18, shows an apparently stable beach formed in 0.05 centimetre sand from an originally flat surface standing at 4 degrees by a series of waves of 6 centimetres amplitude which had so long a wave-length that they did not break. From the outset an instability was noticed. For though the beach contours were repeatedly straightened out by hand during the wave action a low bank was, before long, always formed on one side or the

other; this bank caused the surge to assume a circular sweeping motion across the tank instead of moving directly up and down as it had done on other beaches. Such a bank can be seen at the top of the beach in the figure. Measurement will show that its surface is inclined at the 14-degree angle. It lies on the camera side of the tank, and the lateral movement of the surge was away from it and across to, and then down, the other side of the tank, where there was no bank at all, and where the surface retained the general 5-degree inclination right up to the surge height.

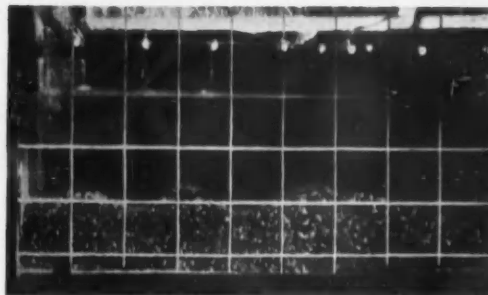


Fig. 21. Rippled stage in the formation of a submerged beach of 0.7 CM. material.

(b) Fig. 19 shows the ground plan of a typical sand beach near Mersa Matruh on the Egyptian coast west of Alexandria. Here an outer reef limits the wave-amplitude to about 60 centimetres, and the whole beach formation is simplified by the lack of tide in the Mediterranean and by a steady shoreward wind which blows at right angles to the beach-line for long periods. It will be seen that the contour lines of the upper beach run in a regular succession of bays, which have an average width of about 12 metres, and are separated by promontories. The beach angle of these promontories approaches, but never exceeds, 14 degrees. The beach angle in the middle of each bay is considerably less, and may be as low as 3 degrees. The profile everywhere is a straight line, and all these straight lines run down to join a common horizontal and unindented step-line. Below the step the lower beach bears transverse ripples as in Fig. 12.

Waves with their straight crest-lines parallel to the general shore-line approach and break when they are immediately over the step. The surge, which piles up thickly against the steep face of each promontory, is divided by it into two diverging streams. The upper fringe of each stream, as it flows inwards towards the hollow of a bay, surrounds and heads off that part of the surge which has flowed directly up the hollow. The two side streams from the promontories on either side meet in the centre and together form a return surge down the hollow of a considerably greater intensity than the previous upward surge there. It should be noted also that owing to the introduction of a sideways flow there is no longer any dead period (except on the front of each promontory) when the water and the sand grains it carries come momentarily to rest. The grains are kept in continual movement and therefore do not get a chance to settle on the bed.

There can be little doubt that both of these effects, the incipient beginnings of which were previously noted in the wave-tank experiments (Fig. 18), are responsible for the fact that the angle of a natural sand beach is less than the experimental 14-degree friction angle,  $\alpha_0$ .

On beaches exposed to less constant winds, waves, and water-levels, the rhythmic production of bays and promontories is not, of course, so pronounced as it is under the ideal conditions on the North African coast.

#### The Size-Grading of the Particles over a Pebble Beach

When using shingle of mixed grain-size—0.5 to 0.9 centimetre—a very distinct sorting-out of the stones took place during the formation of a model-beach. From the lowest point D (Fig. 3), at which bed movement took place, the stones remaining on the surface of the mature shelf dwindled rapidly in size towards the step, until pebbles of the minimum diameter were found by themselves as a transverse belt immediately at the foot of the steep slip-face leading up to the step. The surface material composing

### Beach Formation by Waves—continued

this face was, on the contrary, of maximum diameter. From here to half-way up the upper beach the diameter fell to the general mean diameter of the whole mass. Above this again, the diameter increased with increasing steepness of the beach, till at the crest only stones of maximum sizes were found.

It was noticed, however, that when a fresh layer of new upper beach was thrown up from below and deposited, the selective grading was more apparent than real, being confined, except at the very top of the crest, to the surface only. The reason for this was clear: far more material was always set in motion forwards and backwards than was deposited, and this oscillating layer was a considerable number of grain diameters in thickness. During the motion the oscillating layer itself became graded vertically,



Fig. 22. A submerged beach formed with 0.05 CM. material.

because the small grains tended to fall to the bottom of the layer, leaving only the larger ones at the top. Whenever, therefore, a small permanent deposition took place from the layer, it tended to consist only of the small grains; the largest stones remained and accumulated on the surface of the oscillating layer as more material of the general beach composition arrived from below.

Small quantities of fine material originally mixed with the pebbles disappeared from the beach altogether. All the fine grains were washed downwards and outwards by the circulation of water through the body of the beach, and accumulated on the tank floor at the foot of the shingle beach.

On the whole, it may be said that the model-beach of shingle imitates, in a remarkable way, all the features of its full-scale counterpart.

#### The Effect of Variations in the Still-Water Level (tides) and of Wave-Amplitude, during Wave Action

The effect of a slowly falling tide on an existing model-beach of large shingle ( $R=30$  to  $70$ ) has already been described under the heading "The Initial Beach Profile." The material was left standing at an angle of  $19$  degrees whatever the wave-amplitude might be, and the beach surface was nearly plane. It was unfortunate that time did not permit experiments to be made with fine sand at higher values of  $R$ .

In the case of a steadily-rising tide, it is clear that at any given moment the beach has not reached the mature profile corresponding to the wave and water conditions at that moment, but that the profile approaches maturity as the rate of rise is made slower in relation to the frequency of the wave action. In this connection it may be noted that the experiments brought out that the rate of bulk movement of beach material by waves of a given amplitude varies with the diameter of the grains. Each wave moves a far greater weight of coarse material than of fine material.

Since, for any given material, the beach form depends on the wave-amplitude, and since it does not approach maturity till many waves have acted on it, the profile of a natural beach which is formed by a succession of waves whose amplitude varies at random cannot be as clear cut as the profile of a model-beach formed in the wave-tank.

#### Submerged Beaches at the Foot of a Vertical Wall

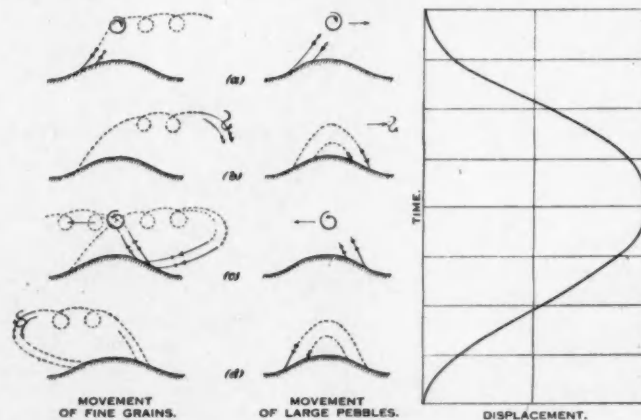
All the foregoing refers to beaches of which the quantity of material was initially large. Experiments were made to see what

happened to the beach profile when a small embryo beach at the foot of a wall was fed with a continuous supply of material, and was allowed to grow progressively bigger. The results showed that the growth of such a beach is discontinuous, and passes through at least two critical stages.

Figs. 20 show the successive stages which were noticed. Material (0.7 centimetre) was fed in gradually at the foot of the beach, and was worked up it by the continued action of the waves. (The wave-amplitude remained the same throughout the experiment, but although in stages (c) to (d) (Figs. 20) the position of the break did not alter appreciably, there was no break at all in stages (a) and (b) because of the feeble distortion of the wave caused by the little embryo beach. In these early stages the wave merely surged vertically up the wall as a true *clapotis*).

It will be seen that at stage (b) the beach had risen to such a height that the scour caused by the collapse of the *clapotis* down the wall had formed a trench in the beach immediately against the wall. As more material was added this scouring action at the wall prevented the beach there from rising any higher. The material therefore accumulated farther out. The growth of this accumulation presently caused the wave to break before reaching the wall. At this stage (Fig. 20 (c)) a chain of two or three acceleration ripples appeared (Fig. 21). These travelled slowly outwards from the scour trench, which was consequently deepened and widened.

This ripple system appeared to be unstable, for it broke down without the addition of any more material. When the scour trench had grown to a maximum size, the accumulated material farther out was suddenly and rapidly moved forward to fill it up and obliterate it. The beach once more rose to a crest against the wall; but now the crest was exposed at low-water. The profile is shown in Fig. 20 (d). This new crest rose steadily but concurrently a fresh accumulation of material began farther out, so that the beach angle grew smaller. A second critical stage was reached when the beach angle attained the minimum value of  $14$  degrees (stage (e)). This stage appears to correspond with the condition described on p. 40 and in Fig. 15. Finally the addition of more material caused another sudden forward movement of the beach. The beach angle steepened to  $21$ - $22$  degrees, and the shingle crest, now piled up to the maximum height of the surge, formed a porous barrier between the surge and the wall. After this final stage (f) the addition of more material merely had the effect, already described, of making the whole beach advance to seaward without change of profile. Fig. 22, shows a typical submerged beach formed with fine 0.05-centimetre material.



Figs. 23.

#### Acceleration, or Oscillation Ripples

The formation of long continuous regular ripples on the surface of a nearly horizontal sheet of beach sand is familiar to everyone. But the great similarity in form between these beach ripples and the familiar wind ripples seen on the surface of a sand dune has led to the commonly-held view that the same mechanism is re-

### *Beach Formation by Waves—continued*

possible for both. This is most unlikely, for two reasons: (a) the wind ripple is formed under a steady uni-directional flow of the air, whereas the conditions under which the beach ripple is formed are invariably those of an oscillatory bed movement caused by the passage of wavelets through the water above; (b) ripples formed on the bed on a steadily-flowing stream of water, although they may assume a variety of shapes, never resemble either the wind or the beach ripple.

Transverse beach ripples have been produced in the wave tank not only with sand, but also with shingle up to 0.9 centimetre in diameter. With this large material the movement, both of the individual grains and of the surrounding water, can be watched with great ease.

The peculiar motion set up during each stroke of the water oscillation results without doubt from the acceleration of the water mass rather than from its acquired velocity of flow. The motion is utterly unlike that seen during sand-ripple formation under steady flow conditions either in a water-flume or in a wind-tunnel.

Successive phases of the motion, in the cases of both fine and large grains, during one complete wave cycle are sketched on the left-hand side of *Figs. 23*. The displacement-time curve on the right indicates the phase of the cycle to which the sketch on the left refers.

*Phase (a).* The initial acceleration causes a violent surge up the left-hand side of each ripple. This removes grains from the surface and carries them high into the fluid above. At the same time the fluid above acquires a rapid clockwise spin about a horizontal axis parallel to the ripple direction. The rising grains are swept into the vortex. If they are small they are carried round and round inside it; larger grains appear merely to move round through the upper semicircle before dropping out again. In both cases the mean linear velocity of the water carries the vortex across to the opposite side of the ripple.

*Phase (b).* Retardation of the general linear water-motion has the effect of checking the angular velocity of the vortex. The grains leave it and begin to fall. By the time the linear velocity has ceased at the end of the stroke the vortex has begun to turn inside out and to disintegrate. The falling grains may or may not have reached the ripple surface, depending on their rate of fall. In the case of fine grains they may be carried far beyond the precincts of their own ripple.

*Phase (c).* If the grains are large they have already fallen on to the right-hand side of the same ripple from which they rose. If they are small they are still falling. The reverse motion of the water carries them back, so that they still fall on to their own ripple. In the meantime the acceleration of the water and the consequent surge up the right-hand side of the ripple has picked up other grains and carried them high into the fluid above. The vortex, now anti-clockwise in direction, passes over the ripple and involves the rising grains in its motion.

*Phase (d).* Retardation destroys the vortex; grains fall towards the surface. Large grains reach the left-hand side of their own ripple before the end of the stroke; fine grains are carried on to the left beyond their own ripple, but return again during the following phase (a).

The formation of these acceleration ripples displays several interesting features: (a) If the water oscillation is symmetrical, the grains tend to remain associated with their own particular ripple. In this case the ripples remain stationary. If the oscillation is not symmetrical there is a drift of grains from ripple to ripple, but it is not yet clear whether this must always involve a movement of the ripple itself. (b) The mechanism allows of great constancy of ripple wave-length over a very wide range of grain size and oscillation amplitude. When the grain size is small the grains are carried farther, but their low terminal velocity allows of their being carried back again to their own ripple before they reach the surface. If the period of oscillation remains of the same order, an increase in wave-amplitude involves an increase of acceleration at the beginning of each stroke. Furthermore, since the effect of acceleration appears to be to raise the surface grains vertically upwards, an increase of amplitude therefore causes them to rise higher than before. The water-displacement carries them farther during phases (a) and (b), but

they remain longer in the fluid and have more time to be carried back to their own ripple during phase (c). (c) The alternate creation and destruction of large and violent vortices must absorb and dissipate a considerable amount of energy from the layers of water near the bed surface. This probably accounts for the rather surprising fact that the level of the shelf does not fall when the size of the particle is reduced. There seems to be some automatic adjustment whereby the damping effect of the ripples on the bottom water-movement in each case just counteracts the increasing mobility of the smaller grains.

## *National Harbours Board of Canada*

### *Excerpts from Annual Report for Calendar Year 1941*

#### **Shipping and Cargo Tonnage**

The aggregate volume of shipping at harbours administered by the Board showed a moderate increase during 1941, as compared with the previous year. Vessel arrivals numbered 47,445, which was 1,345 greater than the number of entries in 1940. The aggregate net registered tonnage was 38,658,683 in 1941, as compared with 36,658,366 in 1940.

The volume of water-borne cargo tonnage in 1941 was 29,902,518 tons (W. or M.). This figure compares with 29,722,815 tons in 1940, the increase being 179,703 tons. Vessel ballast (non-revenue), bunkers, ships' stores, mail and passengers' baggage are excluded for both years. There was a substantial increase in external traffic, but domestic water-borne tonnage fell off notably, owing to the diversion of inland water carriers from their normal operations. This applied particularly to the carriage of grain by water to ports on the St. Lawrence River.

#### **Revenues and Expenditure**

Operating revenues were again the highest on record, amounting to \$11,189,429 in 1941, compared with \$10,602,199 in the previous year, an increase of \$587,230, or 5 per cent. Expenses of administration, operation and maintenance were \$4,919,289 and showed an advance of \$412,462, or 9 per cent., over the figure of \$4,506,827 reported for 1940. This was due, in part, to increased costs of materials and wages, including cost-of-living bonus paid to employees and, in part, to expansion in operations, particularly of such facilities as terminal railways, cold storage, warehouses and floating equipment. Operating profit for the year was \$6,270,139, as compared with \$6,095,372 in 1940, an increase of \$174,767, or about 3 per cent.

After taking into account miscellaneous income debits and credits and providing for interest and reserve for replacements, the net income deficit for the year was \$3,514,880, as compared with \$3,737,149 in 1940, showing an improvement of \$222,269.

The harbours of Halifax, Saint John, Chicoutimi, Quebec, Three Rivers, Montreal and Vancouver had aggregate operating revenues in 1941 of \$10,739,388, as compared with \$10,034,760 in 1940, an increase of \$704,628, or 7 per cent. Expenses of administration, operation and maintenance increased from \$4,211,597 in 1940 to \$4,650,727 in 1941, or by \$439,130, or 10 per cent. Operating income was \$265,498 greater than in 1940.

After taking into account miscellaneous income charges and providing for interest and reserve for replacements, a net income deficit of \$3,694,848 was shown in 1941, as compared with \$4,006,837 in 1940, an improvement of \$311,989.

#### **Capital Expenditures**

Expenditures charged to capital account in 1941 amounted to \$1,549,664. An additional sum of \$10,086, charged to replacement reserve, was expended on replacement of physical assets, the total outlay being \$1,559,750.

The Report is signed by Messrs. R. K. Smith, Chairman; A. E. Dubuc, Vice-Chairman; B. J. Roberts, and F. W. Riddell, Executive Secretary.

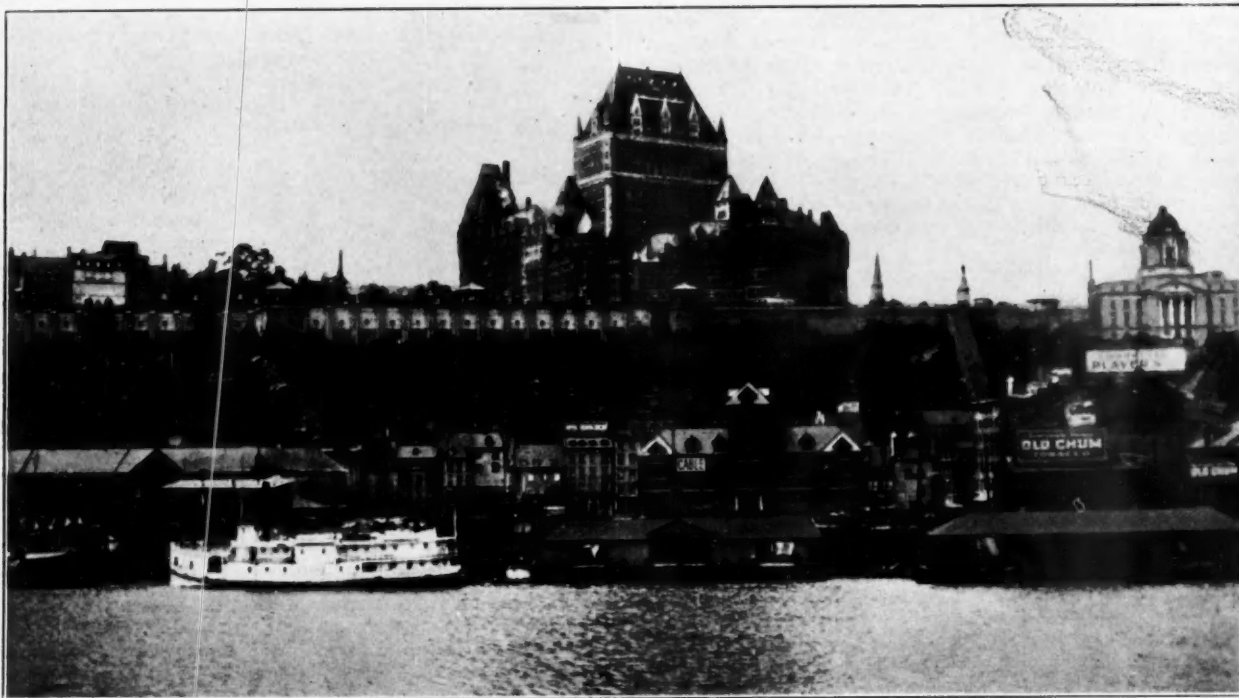
### National Harbours Board of Canada—continued

The following is a concise statement of the accommodation and shipping facilities at the several harbours within the Board's jurisdiction:

**Harbour of Halifax.**—The Harbour of Halifax, situated on the Atlantic Coast of Nova Scotia, is approached directly from the ocean by a channel with a minimum depth of 50-ft. at low tide. It is open to navigation the year round and is served by both the Canadian National and Canadian Pacific Railways. Here, the National Harbours Board operates 7 main piers and wharves having about 13,600 linear feet of berthing and being equipped with 13 transit sheds with an aggregate floor area of about

Saguenay flows into the St. Lawrence River at a point 130 miles below Quebec. The facilities operated by the Board include: 2,600 lin. ft. of wharf allowing ships of 30-ft. draft, a concrete fireproof shed, 400-ft. by 60-ft., a frame shed 150-ft. by 40-ft. and about 8,500-ft. of standard gauge railway tracks connecting with the Canadian National Railways.

**Harbour of Quebec.**—The Harbour of Quebec is situated at the confluence of the St. Lawrence and St. Charles Rivers, about 160 miles below Montreal. It is open to ocean navigation for about 8 months in the year. The facilities operated by the Board include 4 main piers and wharves having 20,425 lin. ft. of berth-



Port of Quebec. Portion of River Front, showing Chateau Frontenac and Dufferin Terrace.

1,100,000 sq. ft. In addition, the Board manages a 2,200,000 bushel grain elevator with a maximum unloading capacity of 75,000 bushels per hour and a marine tower with an unloading capacity of 15,000 bushels per hour; also a cold storage terminal warehouse, with about 1,075,000 cub. ft. of storage space, completely fitted with freezing, storing and packing equipment and ample rail connections. A cattle shed with yards and runways, with a capacity of 1,000 head, is provided at a location convenient to both water and rail.

**Harbour of Saint John.**—The Harbour of Saint John, situated at the mouth of the Saint John River on the North Shore of the Bay of Fundy, is open to navigation the year round and is served by both the Canadian Pacific and the Canadian National Railways. It is accessible from the sea by a main channel 600-ft. wide with a minimum depth of 30-ft. at extreme low tide. Here the Board operates 19 deep water wharves having some 11,800 lin. ft. of berthing with available drafts alongside varying from 25 to 35-ft. at extreme low water and 16 transit sheds, including 2 frostproof sheds, with an aggregate floor space of about 745,000 sq. ft., all with rail connections. The Board's grain elevator, on the west side of the harbour, has a storage capacity of 1,500,000 bushels, and is connected to 9 of the berths by over 2 miles of conveyor galleries with a shipping capacity of 60,000 bushels per hour. A 45-ton fixed derrick is available at berth 1, Navy Island. A 15-ton floating derrick is also available together with scows for lighterage.

**Harbour of Chicoutimi.**—The Harbour of Chicoutimi is situated on the Saguenay River about 75 miles from its mouth. The

ing, 10 transit sheds with a total floor area of 743,642 sq. ft., 32 miles of standard gauge terminal railway, connected with both Canadian Railways, a grain elevator with a capacity of 4,000,000 bushels and 2,000 lin. ft. of shipping galleries with a loading capacity of 90,000 bushels per hour, 3 marine towers unloading boats, also, a modern cold storage warehouse with a capacity of 500,000 cub. ft., and a fish house with a capacity of 1,000,000 pounds, a floating crane of 50 tons capacity and 3 locomotive cranes with capacity up to 38 tons.

**Harbour of Three Rivers.**—The Harbour of Three Rivers is situated at the confluence of the St. Lawrence and St. Maurice Rivers, about 81 miles below Montreal. It is open to navigation for about 7½ months in the year. The facilities operated by the Board include 3 main wharves having some 7,400 lin. ft. of berthing with a minimum water depth of 30-ft. alongside and 9 transit sheds with a total floor area of about 192,000 sq. ft.

**Harbour of Montreal.**—The Harbour of Montreal is situated on the St. Lawrence River approximately 1,000 miles inland from the Atlantic Coast, and is reached by ocean shipping through a dredged channel having a minimum depth of 32½-ft., now being completed to 35-ft. It is served by both Canadian railways connected to the harbour front by 60 miles of terminal railway operated by the National Harbours Board. The harbour is open to navigation from about the middle of April to the beginning of December of each year. The Board operates main piers, wharves and jetties providing 116 berths, totalling over 10 miles of berthing accommodation; 26 transit sheds with an aggregate floor area of over 2,040,000 sq. ft.; also four grain elevators with a total storage

capacity of over 15,000,000 bushels and  $3\frac{1}{2}$  miles of grain conveyor galleries; and a cold storage warehouse with a capacity of 4,628,000 cub. ft. A 75-ton capacity floating crane and several locomotive track cranes are available.

**Prescott Elevator.**—Prescott Elevator is situated on the St. Lawrence River about 118 miles upstream from Montreal and 60 miles downstream from Kingston. The facilities operated by the Board include: a grain elevator with 5,500,000 bushel storage capacity with 4 travelling marine towers, each with a capacity of 35,000 bushels per hour, 5,400 linear feet of wharf and adequate railway trackage.

**Port Colborne Elevator.**—Port Colborne Elevator is situated at the Southern or Lake Erie entrance of the Welland Ship Canal. The facilities operated by the Board include 2,400 lin. ft. of wharf and a grain elevator with a storage capacity of 3,000,000 bushels with 4 marine legs with an unloading capacity of 18,000 bushels per hour each.

**Harbour of Churchill.**—The Harbour of Churchill is situated at the entrance of the Churchill River on the West side of Hudson Bay. It is open to ocean navigation from about the beginning of August to the middle of October. The facilities operated by the Board include: 1,855 lin. ft. of wharf with a depth of water alongside of 30-ft. at low tide, a steel transit shed 476-ft. long by 173-ft. wide, a grain elevator with storage capacity of 2,500,000 bushels equipped with galleries and spouts allowing the loading of three ships at a time, railway tracks along the wharf, two locomotive cranes of 15 and 20 tons capacity, a floating crane of 20 tons capacity, a gantry crane of 35 tons capacity, cattle pens capable of holding 400 head of cattle and a marine slipway capable of handling boats up to 1,200 tons weight.

**Harbour of Vancouver.**—The Harbour of Vancouver, situated in Burrard Inlet on the West Coast of British Columbia, with direct access to the Pacific Ocean through the Straits of Georgia and Juan de Fuca, is served by the Canadian National, Canadian Pacific and Great Northern Railways, which have connections, either direct or over the terminal railway operated by the Board, to all docks on the North and South sides of the harbour. The entrance channel to the harbour, which is open the year around has a minimum depth of 35-ft. The Board operates three piers and two jetties having about 9,500 lin. ft. of berthing and 6 transit sheds with an aggregate floor area of about 567,000 sq. ft. The Board's four grain elevators have a total storage capacity of 9,816,500 bushels, a combined loading capacity of about 200,000 bushels per hour and  $1\frac{1}{2}$  miles of conveyor galleries. Besides, there are provided storage tanks with a capacity of over 470,000 Imperial gallons for the handling of fish and vegetable oils, open wharves, booming grounds and scow pools for the storage and shipment of timber and a special dock with small ice plant and freezing equipment for the processing of fish.

## Reviews

### *Foundations in Disturbed Ground*

The Institution of Structural Engineers have performed a service, which will be generally appreciated, in issuing, at the price of one shilling, **Part I** of a **Report on Foundations**, dealing with Foundations in Disturbed Ground. Owing to the widespread devastation and disruption by enemy bombing attacks of building areas, including those within port precincts, the information and advice contained in the booklet of 12 pages will be found extremely useful. But while ground disturbed by enemy action certainly is an outstanding feature at many sites, the Report is not limited to the consideration of disturbance of that description, but includes re-deposited or tipped ground; disruption or disturbance by explosions generally; undermining by natural or artificial drainage, pumping, or the removal of support by adjacent excavation; chemical changes due to the ingress of effluents, etc.; and rapid geological disintegrating or disturbing agencies.

The actual testing of sites selected for building operations is, undoubtedly, the most satisfactory method of determining its bearing capacity, and should be adopted wherever possible, but the report under consideration, while enunciating certain general principles, does not attempt to discuss testing methods in detail. Attention is, however, directed to the unsuitability of the old practice of simply setting the foundations of dwelling houses just below the level penetrable by frost. Other considerations must now enter into account.

Building Bye-laws and Regulations are alluded to, and certain defects in the requirements of the L.C.C. Bye-laws and the Model Bye-laws of the Ministry of Health are pointed out. It is recommended that there should be a codification of "design" in place of the indefinite stipulation for "due stability." Undoubtedly there is necessity for supersession of the old rule of thumb methods by others based on rational principles and exact tests.

The booklet can be obtained from the office of the Institution, 11, Upper Belgrave Street, London, S.W.1 (postage 1d.).

**Concrete Simply Explained**, by Victor S. Wigmore. Pp. 48. Price 1s. 6d. (by post 1s. 8d.). The Society of Engineers, Inc. (War Emergency address: 56, Church Street, Weybridge Surrey).

The writer of this highly commendable little brochure explains in a Foreword that it is intended "for the men who handle concrete (including the man at the mixer) as well as for students of Structural and Civil Engineering." Written in plain, straightforward, simple language, we cannot imagine anything better adapted to the purpose in view. There is an absence of all abstruse and speculation theory, and the whole process of concrete making and manipulating is explained in a practical way; indeed, some of the directions may even be of service to thoroughly qualified technicians. There are five chapters, each devoted to a subdivision of the subject, viz.: Cement, sand, coarse aggregate, water and concrete; and we note with approval that the author lays stress on the importance of gauging the water content accurately. The generality of text books on the subject are rather apt to treat the matter with indifference, overlooking the injury to the concrete which may result from either an excess or an insufficiency of water.

Without wishing to be captious, we may perhaps regret that the author has not specifically stated the numerical values given in the British Standard Specification for the tensile and compressive tests of Portland Cement briquettes, nor does he point out the necessity for a marked increase in strength at the end of 7 days, as compared with 3 days. But these omissions do not invalidate the utility of the manual, which is worthy of the careful perusal of all who are concerned in the use of cement as a structural material.

The text is reprinted from the Transactions of the Society of Engineers, with an Introduction by Mr. Tony Jules Guérin, the well-known Ferro-concrete practitioner, and a Preface by Mr. R. H. Harry Stanger, whose laboratories are in frequent service for cement testing purposes. There is a useful index.

## Obituary

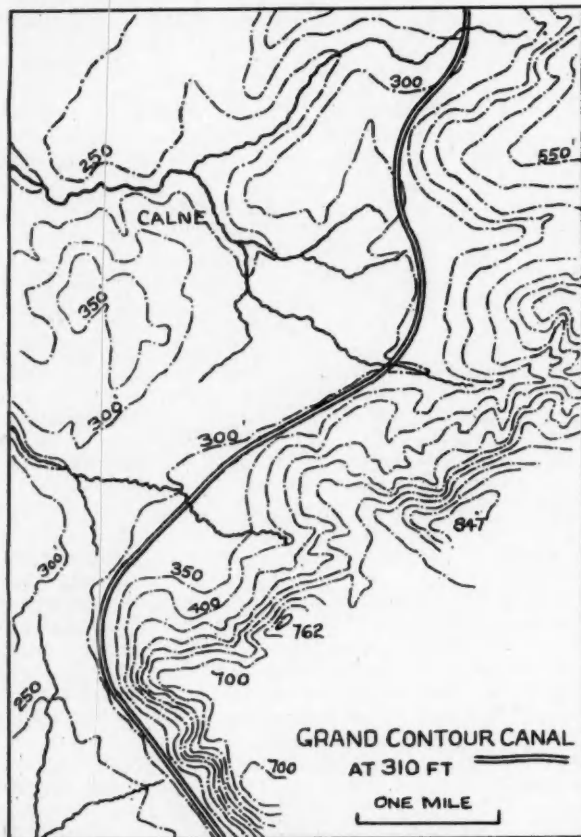
The death took place at the end of June of **Sir Edwin Cooper**, the eminent architect, who designed the Port of London Authority Building in Trinity Square, London, E.C.3, and Lloyd's Building and its neighbour, Royal Mail House, in Fenchurch Street, E.C.3. He was also responsible, among a great number of other structures, for the design of the Customs Hall and Railway Station adjacent to the Tilbury Landing Stage. Sir Edwin, who was born in 1873, had a distinguished career. He became a Fellow of the Royal Institute of British Architects in 1903, an A.R.A. in 1930, and a R.A. in 1937. In 1931, he received the Royal Gold Medal of the Royal Institute of British Architects and was elected an honorary member of Lloyd's in 1928, "in recognition of his work as an architect and as a mark of appreciation of the great services rendered to the Corporation."

## Correspondence

To the Editor of "The Dock and Harbour Authority."  
The Grand Contour Canal.

Sir,—

Needless to say, I greatly appreciate the references in your June number to my project for a Grand Contour Canal. For an explanation in brief of the principle which enables the projected canal to maintain a uniform level, taken as 310-ft., one may say, roughly, that the canal follows a kind of persistent "shore line" where soft clays abut against harder rocks which outcrop as hills. The accompanying contour map shows the effect at its best, the 300-ft. contour piloting the canal very easily through a countryside of bold relief.



The 300-ft. Contour as a "Natural Canal Line," along the Southampton Branch.

Of course, this formation is not always so perfect, but Mr. C. A. Wilson's comparison of certain necessary tunnels with the Mersey Tunnel is unfortunate, because a canal tunnel under an estuary would be an unheard-of work, whereas a fair comparison would be with the Rove Tunnel, Marseilles, to which the projected tunnels would be similar in cross-section, and one of them, the Pennine Tunnel, between Skipton and Clitheroe, would be similar in length also.

The canal would draw, in time of drought, from water stored in permeable beds, which in times of copious flow it would replenish from such adequate streams as the Dee, Wharfe and Ure. In its water grid aspect it is noteworthy that the Grand Contour Canal would save Coventry a million pounds, the capital cost of a scheme in view for pumping water up 300-ft. from the Severn.

In page 24 of your June number, there is a reference to special type barges on the Mississippi for light, bulky, cargo, in the case of new motor cars up to nearly 300 per barge. This is interesting as a precedent for similar vessels and traffic on the Grand Contour Canal.

The projected line at 310-ft. level is marked on 1-in. Ordnance maps, and I should be glad to pencil the exact line on any maps sent to me with return postage.

Yours faithfully,

The York Hotel,  
138, Tettenhall Road,  
Wolverhampton.  
13th July, 1942.

J. F. POWNALL.

To the Editor of "The Dock and Harbour Authority."

### British Canal Traffic

Dear Sir,—

Why should Inland Transport Expenses in Great Britain be so much dearer than on the Continent?

As one who has been engaged in shipping and general transport for over 40 years, of which over 30 years have been spent in Rotterdam and Antwerp, I have always felt great sympathy for British Exporters and Manufacturers who were stubbornly fighting back under considerable and increasing odds.

There were odds for which there was hardly a remedy—for instance, the open or hidden assistance which German exporters and manufacturers received from their Government. There are, however, other odds which can be remedied, and I feel that the matter of inland transport costs is of imminent importance, as transport expenses play a great part in the price of many articles, and especially so for raw and heavy materials.

This is particularly the case in peace time when the production prices of commodities are low. Transport expenses, in short, can make commodities marketable or not.

Coming to the point I wish to make, why are inland transport expenses in the principal commercial and industrial countries, which are amongst our main competitors in the economic field, so considerably cheaper than in this country?

In this respect there is no doubt that on the near Continent the inland waterways, such as regulated rivers and canals, have been playing an all-important part. In Holland, for example, where almost every town and even village is connected with the rest of the country by canals or rivers, transport by water is very cheap. For instance, Amsterdam to Rotterdam, about 50 miles, about 2s. per ton; Rotterdam to Antwerp, about 70 miles, about 2s. 6d. per ton; Groningen to Rotterdam, about 170 miles, about 5s. per ton.

In 1914 about 92% of all traffic in Holland was water-borne. Since then, road traffic has been developed, and the real push of the roads came when lorries driven by Diesel engines were introduced. Water-borne traffic, however, has remained strong.

It is perhaps not fair to compare Holland with this country, in so far that Holland is so flat, and rich in water. However, Belgium, France and Germany also have canal systems, which are most impressive. It is rare to find canals in those countries which cannot accommodate barges up to 250 tons. The Albert Canal from Antwerp to Liege, partly in hilly country, was designed for vessels up to 2,000 tons.

When one compares those canals, say, with the Grand Junction Canal—a canal which connects London, the world's largest city, with Birmingham and other important centres—a canal which can only accommodate barges carrying about 40 tons—one gets a feeling of intense depression.

The rate of freight with these small barges from London to Birmingham is about 10s. per ton, about four times the figure charged on the Continent for a similar distance by canal.

It is tantalising to think of the freights which the Huns are paying for their export commodities from their industrial centres like Duisburg, Dusseldorf and Cologne—rates of freight like 1s. 6d. and 2s. per ton, to alongside steamers at Rotterdam and Antwerp.

In a subsequent letter I may perhaps be permitted to set out my views on the causes and consequences of this state of affairs, as well as on the practical steps which should be taken to overcome these odds, if we are going to give our industries their fair chance after the war.

Yours faithfully,

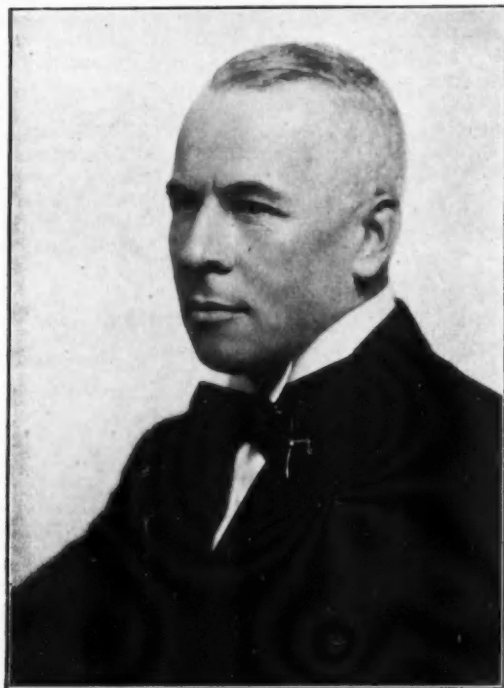
"JACK HOLLAND."

London, 20th July, 1942.

## Notable Port Personalities

### XXV—Mr. John Gibson Jarvie

Born at Carluke, Scotland, in 1883, **Mr. John Gibson Jarvie**, Regional Port Director for the North-western Area, was, in his youth, "apprenticed" to law in his native country and later went to London, where he was subsequently called to the Bar (Middle Temple). He lived in America for some years and there became vice-president of a famous financial house. Subsequently, in London, he founded the United Dominions Trust group of commercial bankers, of which he is still chairman, and established subsidiary companies in South America and Rhodesia. He has travelled extensively in Canada, the United States of America, South Africa, the Middle East and Russia.



Mr. JOHN GIBSON JARVIE.

Until the outbreak of war, he was president of the Thameside Industrial Development Board. He is also on the board of two London hospitals.

One of his first acts after his appointment by the Minister of War Transport to control the ports in the North-western Area, was to clear up the accumulated port congestion by the establishment of a permit system, by which the flow of goods to the port from inland is regulated by the shipping space available for loading. Less than two months after his appointment, the first of the Dockers' Decasualisation schemes was brought into operation. This gave the Port Director responsibility for the employment of nearly 30,000 dock workers in the ports of Liverpool, Birkenhead, Preston, Garston, the smaller ports along the Manchester Ship Canal, and the Port of Manchester.

The ever speedier turn-round of ships being in the forefront of vital war efforts, the gradual working out of a long term policy was impossible. Therefore, Mr. Jarvie evolved a considered plan which would produce immediate results.

He put piecework rates for deep sea and coastwise cargoes into operation, and pushed forward a canteen scheme, which now provides over 80,000 meals daily for dock workers. He founded in August, 1941, a broadsheet publication called *The Hook*, specially for the information of dock workers. *The Hook's* leading article each month is a personal message from Mr. Jarvie, and its pages are sometimes illustrated by cartoons from his pencil.

In January of this year, he announced the plan to hold the world's first "Dockers' Week." This was, to quote Mr. Jarvie's own words, "a week during which every man will turn up for work promptly; will, by his own behaviour, hasten the allocation of men at the Controls to their different jobs; hurry to the ships and then sweat through every working hour to get cargoes unloaded, or to load supply ships. No slacking, no spelling, no absenteeism—just a solid week of solid first-class work, the kind of work which the dockers can give when they like."

During that "week" many records of loading and discharging were set up, a "Brains Trust" of dry dock experts toured the dockside answering questions posed by the men, the press of the country gave daily reports, and B.B.C. observers broadcast commentaries in six languages.

Mr. Jarvie is now engaged on what he considers to be his biggest dockside task. It began, as he has himself confessed, as a "thought which occurred to me whilst I was speaking to a meeting of dockers in a canteen," but it has become an "industrial experiment" of world-wide interest.

The "Honour Week" plan was thus placed before the dockers: "For the seven days of 'Honour Week' no docker will be disciplined by the Ministry's organisation. He will work on his honour. The responsibility of an all-out effort, and of dealing with any slackers, will be each docker's personal affair. Dockers know how to make the 'turn-rounds' go smoothly and quickly, and if there are slackers, they know how to deal with them. The success or otherwise of the week will rest entirely on results. Those results will be made by dockers without interference, but the results and the conditions prevailing will be carefully watched and recorded. If the results show that dockers themselves will cure slacking, 'spelling,' and absenteeism, 'Honour Week' will form a basis on which to reorganise disciplinary measures."

At the end of the seven days Mr. Jarvie was able to report that "it has been a successful and revealing experiment. No discipline of any kind on the part of the authorities was exercised, yet the work of the port has been efficiently done. In many directions it was speeded up. Time-keeping in general has improved substantially. Temper, an important factor in industrial relations, showed a distinct improvement over normal conditions. Of the men presenting themselves for work, 1.75 per cent. laid themselves open to disciplinary measures. An average of .35 per cent. failed to return to their jobs on the following shift and 1.4 per cent. refused to accept an offer of employment. In the reports from 'Approved Employers,' 8 per cent. recorded 'work above average,' 85 per cent. 'normal' or 'satisfactory' work and 7 per cent. below the standard expected. The below standard work, the reports showed, was due almost entirely to exceptional circumstances or to causes for which remedies will be sought immediately." "Honour Week" was continued for a further seven days and produced almost identical figures.

During the second week, the Port Director made plans to implement his statement that "as a result of the experiment the conditions of dock work in Liverpool are due for some changes—changes in method and organisation. There will be no returning to the former system as a whole. A modified system of supervision and discipline there must be, but it will be more intelligent. The 98 per cent. of good dock workers will be in more human relationship with the port employers and authority." Mr. Jarvie and his executive officers have since been meeting the Port Labour Inspector, Trade Union Delegate, and two representatives selected by the men themselves, from each of the Control Points of the Merseyside docks. The general problems and those peculiar to each Control Point are being frankly discussed, and on the data supplied by these meetings, the changes in dock conditions are being based.

#### Proposed Free Zones at Texan Ports.

A movement is on foot to establish a Foreign Trade or Free Port Zone at the Port of Galveston, Texas, U.S.A. Negotiations to this end are proceeding between the General Manager of Galveston Wharves and the United States Department of Commerce. The purpose is to divert Latin-American shipments to the Gulf ports instead of their passing through the more exposed route to the Atlantic ports. Facilities have also been inspected at the Port of Houston, Texas, with the same object in view.

## Ports of the United States and their Traffic

Address by Colonel J. S. BRAGDON, of the U.S. Army, at the Thirtieth Convention of the American Association of Port Authorities\*

The uninformed are apt to take our harbours and inland waterways largely for granted as Nature's gifts to a fortunate people. You and I know, however, how far from the fact is such a view. Were we to revert overnight to the original harbours and waterways as Nature provided them, our whole industry and economy would be paralysed.

Nature has been bountiful, but our harbours to-day are largely the result of the planning and work of our citizens.

The Engineer Department, as the governmental agency, builds and maintains the channels and turning basins required by commerce and authorised by Congress; the bodies which you represent furnish and administer the terminal facilities without which the channels would be useless. The co-operative teamwork of the two complementary organisations has brought our harbours to their present state. Continuous teamwork alone can keep them efficient and perfect them to meet all future demands.

That our respective planning and works have been measurably intelligent and successful has been proved by the exigencies of the past few years and of the present. The chaos inflicted upon the world by a few aggressive and unscrupulous individuals and peoples has imposed upon water transportation additional burdens taken only lightly into account in our original planning. It might not have been surprising had our harbour facilities proved inadequate to meet those burdens, but they have not proved inadequate.

In some, usually minor and isolated cases, new channels have had to be dredged or old channels deepened. The Engineer Department has done or is doing that work as rapidly as the funds therefor become available. Doubtless port authorities and terminal owners have also, in many instances, been faced with serious problems connected with the emergency which have taxed their ingenuity and resources. But by and large, as far as it is known, the emergency demands upon our port facilities have been met promptly and adequately, with no serious delays or disruptions of essential services and with even a margin of safety against future and even greater demands.

### Port Trade in 1940

The extent of those demands is evidenced by the commercial statistics which the Engineer Department compiles annually for publication in the Annual Report of the Chief of Engineers.

Despite the loss of ships and markets due to the war, approximately 608,000,000 tons of freight were moved through our ports during 1940, surpassing the previous record year, 1929, by some 25,000,000 tons. Of that tonnage, 403,000,000 tons passed through coastal harbours and 174,000,000 tons through Great Lakes ports—an increase of 17,000,000 and 35,000,000 tons respectively over the commerce of 1939.

Statistics already gathered for 1941 indicate that the traffic for the current year will be even greater than that of last year. Thus our harbours are now handling an average of some 2,000,000 tons of freight every day—enough to fill about 500 long freight trains or 200,000 big trucks.

Approximately one-half of the total tonnage moved through our ports annually continues to be petroleum products with about 300,000,000 tons. Next in order are coal and coke (about 160,000,000 tons), and iron ore (over 100,000,000 tons). Grains, iron and steel and lumber account for 12,000,000 to 15,000,000 tons each.

These statistics, which do not include the large tonnages moved on our inland waterways, emphasise the importance of our harbours in the basic economy of the nation.

The United States has undertaken to play its part in the present struggle by providing the materials of war to those who are waging the fight against the aggressors. We have also undertaken to arm ourselves so that if circumstances or whatever nature force us

further into actual hostilities, we shall be completely prepared.

To that end Congress has appropriated billions for defence production and will doubtless appropriate billions more. Our industry has been reorganised, expanded and accelerated toward that purpose and may be expected to be even further geared up to emergency production. Tanks, planes, ordnance, munitions and other supplies have merely begun to flow from our assembly lines and factories and farms; a year or two years from now the present production will be multiplied many times.

All those supplies destined for foreign fronts must reach them by water through our ports; many raw materials from foreign lands required in their manufacture must reach us in like manner.

### Port Developments

The channel widths and depths of our home ports are confidently expected to be generally adequate to carry the additional traffic so imposed on them, but additional capacity will be provided as needed. New roadsteads and facilities (which it is not appropriate at this time to describe in detail) are being provided at our island bases, and additional channels are also being provided or existing channels enlarged at our home ports to afford access by water to new air fields, camps, depots and other Army and Navy bases. Thirty-two Army air fields are being built in the South-eastern Division and about 55 C. A. A. airports. Of course, most of those are inland, but to the extent that some are on the Coast, particularly in the case of one depot, we have had to do some extensive dredging to get in there.

The maximum draft of naval vessels has been up to about 31-ft. but the largest ships and newest facilities require depths of somewhat over 40-ft. Drafts of lighter vessels such as cruisers and destroyers are, of course, considerably less. An over-depth allowance to care for ships set low in the water because of damage in action is desirable for channels leading to repair yards.

The largest commercial vessels, the *Queen Mary* and the *Queen Elizabeth*, draw 39-ft. while the *Normandie* draws 37-ft. The general draft of the larger ocean liners is 25 to 30-ft. and of coastwise passenger ships 18 to 24-ft.; 18% of the vessels of the ocean-going merchant ships of the United States, carrying 70% of the tonnage, have drafts of 27-ft. or less. Tankers are among the deeper-draft vessels entering our ports, the larger drawing from 28 to 34-ft. The general draft of our Great Lakes freighters is about 20-ft., but the tendency is toward larger vessels and the Federal projects on the Great Lakes now provide for a draft of 24-ft.

The C-1 "B" type cargo ship of the Maritime Commission has a draft of 27-ft. 7½-in. fully loaded at 9,270 dead-weight tons. The C-2 type draws 25-ft. 10½-in. when loaded to 9,750 tons dead-weight. The C-3, 28-ft. 7½-in. when loaded to 12,532 tons dead-weight.

Vessel drafts and channel depths in our harbours have paced each other for many years. The designed draft of commercial vessels has always closed up on every foot of channel depth made available. The latter, in turn, try to forge ahead to provide an added margin of convenience and safety to shipping. This healthy pacing or competition of depth versus draft, if you will, to meet the needs of commercial navigation has resulted in harbours which can also meet the needs of all types of naval craft in time of war.

Of our coastal ports, New York is now a 45-ft. harbour, Boston, Philadelphia, Baltimore, Norfolk, Newport News, San Diego, Los Angeles and San Francisco provide depths from 36 to 40-ft. Nineteen other ports, including nearby Port Everglades, afford from 31 to 35-ft. of water. Twenty-eight, including Miami Harbour, fall in the class between 26 and 30-ft.

### Port Tonnage Trends

An analysis of the detailed statistics of port tonnage increase during 1940 reveals certain trends which are to be expected and are interesting. First, the larger ports gained somewhat at the expense of the smaller ports. Many of the latter have had their services sharply curtailed or even completely discontinued in order that shipping might be diverted from lesser and relatively unimportant movements to the services essential to defence.

Second, the tonnage gains have been made largely by North Atlantic and Great Lakes ports. Even the larger Pacific and Gulf ports, with the exception of New Orleans, have barely held their own or even shown some decrease.

\*Delivered in November, 1941, and, therefore, prior to the actual entry of the United States into the war.

## Ports of the United States and their Traffic (continued)

The greatest increase in both absolute tonnage and per cent. was experienced by Duluth-Superior, where the tonnage for 1940, mostly iron ore, totalled over 54,000,000 tons in 1940 against some 38,000,000 tons in 1939—an increase of over 16,000,000 or 42%. The next largest absolute increase was over 10,000,000 tons for New York Harbour, but this represented an increase of only some 6%.

Boston, Philadelphia, Baltimore and Hampton Roads experienced increases of from 1,000,000 to 4,500,000 tons or from 6% to 13%.

Third, the increases have occurred in basic materials needed for defence production. The largest tonnage increase was that of nearly 28,000,000 tons of coal and coke, or 23.6% over the 1939 movement. The largest percentage increase was in iron and steel, which jumped from 7½ million tons in 1939 to over 17 million tons in 1940—an increase of 131%. Logs, petroleum products, sand, gravel and stone, and cement all experienced large gains, ranging from 59% in the case of cement to 11% for petroleum products.

While some of the lesser ports have felt the pinch of diversion of shipping to emergency services, with the added tonnage which must soon be moved, together with the new ships and new facilities being built to move it, many of these lesser ports may expect to be called on to take some of the load from the larger ports.

Because our ports and channels and their facilities have thus far met and are meeting the demands upon them due to the present emergency, we cannot become complacent in the belief that little more will be required of us. We do not yet know how great the load will be as the emergency grows. We must be alert to meet new shipping demands. The Engineer Department will have to carry the responsibility for the waterways and roadsteads. You, its team mates, should be prepared to push development of terminal facilities to keep the ship-to-shore and shore-to-ship flow unbroken.

## Maritime Services Board of New South Wales

### Excerpts from Sixth Annual Report for the Year ended 30th June, 1941

#### PORT OF SYDNEY.

**Financial.**—The accounts for the year ended 30th June, 1941, show a net surplus of £248,023 3s. 11d., which is a decrease of £53,175 3s. 1d. as compared with the previous year, when the surplus was £301,198 7s. 0d.

The Reserve Account now stands in credit to the extent of £1,532,387 15s. 11d. Attention is, however, directed to the fact that this figure was arrived at without provision being made for the depreciation of the Board's wasting assets, amounting to approximately £5,000,000 at the Port of Sydney.

**Income.**—The net income earned during the year was £1,150,452 7s. 6d., being a decrease of £52,774 11s. 7d., or 4.38 per cent., when compared with the figures for the preceding year.

**Oversea Trade.**—The Board's principal source of revenue is wharfage rates on overseas imports, and this section of the trade of the Port was necessarily affected by the restriction of imports, the shortage of shipping and other causes arising out of the state of war. The revenue for the year amounted to £245,073 17s. 4d. as compared with £342,467 4s. 4d. for the preceding year, a decrease of £97,393 7s. 0d.

The war was also responsible for a decline in the revenue derived from wharfage rates on goods shipped overseas. The collections for the year amounted to £70,118 17s. 10d., being a decrease of £9,951 9s. 0d. as compared with the figures for the previous financial year.

**Inter-State Trade.**—The income from wharfage rates on imports from Inter-State ports was £188,118 9s. 5d., as compared with

£178,213 9s. 7d. for the preceding year, an increase of £9,904 19s. 10d. The increase in revenue in this section was largely due to the Port of Sydney being increasingly used as a distributing centre for the whole of the East Coast of Australia under prevailing war conditions.

The return from wharfage rates on exports to other States was £60,859 14s. 0d., as compared with £62,020 8s. 4d. for the previous financial year.

**Intra-State Trade.**—The increasing use of the Port of Sydney as a distributing centre was also reflected in the income from wharfage rates on imports from Intra-State ports, the amount collected for the year being £108,751 15s., as compared with £88,357 2s. 1d. for the preceding year, an increase of £20,394 12s. 11d.

There was, however, a slight decline in the income from wharfage rates on Intra-State exports, the amount received being £21,344 6s. 5d., as compared with £21,979 16s. 8d. for the previous financial year.

**Revenue Expenditure.**—The expenditure chargeable against income amounted to £902,429 3s. 7d.

Working expenses increased by £13,784 9s. 9d., most of which was due to greater expenditure on maintenance of property and plant.

**Capital Expenditure.**—The expenditure on "capital" work during the year was £58,907 8s. 8d.

#### Works and Improvements

**Nos. 12-14 Berths, Pyrmont.**—Further progress has been made in the remodelling of the premises with a view to providing modern combined passenger and cargo wharves for overseas vessels. The sheds in each case will be two-storeyed, on the upper floor of which accommodation will be provided for Customs officers, as well as facilities for embarking and disembarking passengers. Provision will also be made for the ingress and egress of taxi cabs by way of an overhead ramped bridge from Jones Bay Road.

The foundation and floor for the new shed at No. 13 berth have been completed and the erection of the shed structure is in hand. The present intention is to construct only the lower floor of the shed, the concrete roof of which will be flat and ultimately form the floor of the upper storey.

The foundation for the new shed at No. 12 berth, which work was commenced during the previous year, has been completed and the area has been rolled in preparation for the laying of the floor.

No. 14 berth is being extended and at the end of the year 49 plumb piles and 6 spur piles were fixed in position with 440 lin. ft. of headstock.

The reconstruction scheme provides for a permanent roadway, 60-ft. wide, at the rear of the sheds. Considerable progress has been made in the construction of the roadway, a section, 1,000-ft. by 39-ft., having been concreted and the surface covered with a 3-in. asphalt topping.

**New Passenger Jetty at Manly.**—The reconstruction of the passenger jetty at Manly, has been completed, except for a few minor items, and the ferry service is now being conducted from the new premises.

**Circular Quay.**—The remodelling of No. 2 ferry jetty was proceeded with and the pontoon covering and the greater part of the jetty have been completed. The construction of the remainder of the jetty will be deferred for some time, it being necessary to retain the existing shore building as temporary offices for one of the ferry companies pending erection of the new Circular Quay Railway Station.

The former No. 5 ferry jetty has been demolished and a new jetty and shed have been provided, the architectural features of which conform with the general plan for the treatment of the Circular Quay front.

The scheme also provides for a concrete promenade, 40-ft. wide and approximately 700-ft. in length, along the front of the new ferry jetties. By the end of the year the promenade had been constructed, but not for the full width, from the Western side of No. 2 jetty to the Eastern side of No. 6 jetty. The continuation of the promenade will remain in abeyance until No. 7 jetty has been demolished and reconstructed as part of the general scheme.

**Treatment of Piles against attack by Marine Organisms.**—The systematic treatment of piles, by the floating collar method, against attack by marine organisms was continued throughout the year

## Maritime Services Board of New South Wales—continued

and more than 10,000 piles in various parts of the Port of Sydney received attention.

Since the adoption of the present method of treatment there has been a steady decrease in the number of piles requiring renewal on account of destruction by marine organisms. The cumulative effect of the treatment has been such that during the past twelve months it was not necessary to renew even one pile consequent upon damage by marine organisms. The effect of this remarkable achievement on expenditure in connection with renewal of piles can be appreciated when it is stated that some years ago the cost of such renewals at the Port of Sydney, owing to the depredations of marine organisms, was estimated at the high figure of £24,000 per annum.

In the Board's previous report reference was made to a sudden and severe attack made by *Martesia* (a bivalve) on piles in a wharf structure at Bantry Bay, Middle Harbour, and, as a counter measure, the piles were cased with a tar compound. As it appears that this borer is slowly spreading up and down stream from the point of attack, a special study is being made of its habits and life history in the hope that its activities will be checked before reaching the main wharfage area of the Port.

\*First instalment of this Report appeared in the July issue of "The Dock and Harbour Authority."

A further supplement\* (No. 2) to the report previously published by the Board in regard to investigations carried out in this connection has been issued. Some of the subjects covered by the supplement are:—

Observations on annual cycle of attack.

Efficacy of marine growths as an aid in the prevention of Cobra borer destruction.

Surface decay due to the presence of an ascomycete fungus.

Reaction of turpentine piles to sub-tidal attacks of *Limnoria*.

Floating-collar method for inter-tidal treatment of piles and the recently developed plastic compound casing process for sub-tidal preservation of piles.

**Termite and Fungus Attacks.**—Creosote and toxic dusts were again employed for the eradication and prevention of white ant infestation of wharf timbers. The creosote and toxic dusts are applied by means of portable spraying and blowing units, and, as a result of such measures, there has been a marked decrease in the number of cases requiring attention.

Experiments are still being carried out in connection with the fungus attacks on wharf decking, and it is worthy of note that the procedure at present followed has substantially retarded deterioration of timbers from this cause.

**New Graving Dock.**—The Board having been entrusted with the work of constructing the coffer dam for the new Graving Dock at Garden Island, it was necessary, in the first place, to make extensive diamond drill and water jet borings for the purpose of ascertaining, with accuracy, the composition of the sub-strata of the harbour bed on which the dock is to be built, and this section of the work was completed in January, 1941.

The available plant of the Board was not nearly adequate for the extensive reclamation and constructional work involved, and the deficiency was covered by hiring, or purchasing, additional hopper barges, flat decked punts, steam tugs, pile hammers and cranes.

To date, considerable progress has been made in depositing ballast for the inner and outer toe banks of the eastern and western parts of the coffer dam, and approximately 190 lin. ft. of sheet piling has been driven in connection with the Western section of the dam.

The Board has also agreed to undertake the construction of a fitting-out wharf, to be used in conjunction with the new graving dock when completed. The fitting-out wharf, which will be of a considerable length, is to be erected on a line in continuation of No. 2 berth, Woollloomooloo Bay, and it will be necessary to acquire certain additional plant in this connection.

**Oil Booms.**—A system of oil booms has been designed for impounding oil should it escape as a result of enemy action from oil depots located on the waterfront. An initial length of one thousand lin. ft. of boom has been constructed to provide facilities for training personnel in laying the boom in position. The completed scheme provides for 10,000 lin. ft. of boom, and steps have

been taken to ensure supply of the necessary material when required.

**Congestion at Wharves.**—For some time the Board has experienced difficulty in meeting the demand for wharf accommodation at the Port of Sydney consequent upon the sheds on the wharves being congested with cargo awaiting delivery. It was considered that the congestion was due, in no small measure, to the fact that consignees were taking full advantage of the six days free storage period allowed after completion of the discharge of the vessel in terms of Port of Sydney Regulation No. 24.

Since the outbreak of war, however, Sydney is being increasingly used as a distributing centre for the whole of the East Coast of Australia, and, in view of evidence of delay in removing goods resulting in a general "slowing up," it became necessary, in the national interest, for steps to be taken to expedite dispatch and ensure that the port facilities would be used to the fullest extent.

Accordingly, the Board decided, in order to overcome to some extent the congestion of wharves, to reduce from six days to three days the period during which Inter-State and Intra-State goods may remain on wharves without incurring storage charges, and Port of Sydney Regulation No. 24 was appropriately amended. The free storage period of six days will continue in the case of goods arriving from any place beyond the Commonwealth.

### PORT OF NEWCASTLE.

**Deepening of Harbour.**—The original scheme for improving the entrance to the Port of Newcastle provided for a channel of specified width and uniform depth throughout, but this scheme has been amplified to include a subsidiary area on both the Northern and Southern sides of the channel to facilitate navigation; the depth of these subsidiary areas will not, however, be as great as that of the main channel. The breaking and removal of rock in this connection is proceeding, but progress was retarded to some extent owing to adequate funds not being available.

Dredging operations were continued during the year in the Basin, North Harbour Channel and the Steelworks Channel, as well as at various wharves in the Port.

**Future Development of the Port.**—Certain amendments were necessary to the Board's scheme for the future development of the Port, with a view to co-ordinating the plans of the other Authorities concerned. Agreement has now been arrived at between the parties and the probable sequence of the works first to be undertaken will be:—

1. Construction of new wharf for Intra-State vessels at Merewether Street.

2. Remodelling of passenger ferry landing and adjacent wharf at Market Street.

3. Provision of new boat harbour at Merewether Street.

4. Further new wharfage extending northward from the western end of Lee Wharf Extension.

**Lee Wharf.**—The centre line of mooring posts at Lee Wharf has been removed and replaced with bollards on the kerb and at the rear of the wharf.

A new berth, approximately 460-ft. in length, is now available, following on the completion, during the year, of the low level extension at the western end of the wharf.

### Staff.

During the year there has been an increase in the number of officers of the Board who have enlisted for service abroad, and, as their positions are being kept open, a considerable amount of extra work has been thrown upon their colleagues who have remained behind. In addition, a large number of officers have been called up for service with the Home Forces, and, in order to relieve the situation to some extent, it has been found necessary to engage temporary female junior clerks for the duration of the war.

Officers and employees to the number of 75 are serving in the R.A.N., A.I.F. and R.A.A.F.

The Commissioners desire to express their appreciation of the services rendered by the staff during a period which has necessarily placed a greater strain upon it than usual, owing to the many added activities and responsibilities of the Board in connection with the war effort and construction of the new graving dock.

The Report is signed by G. D. Williams, President; W. O'Connor, Vice-President; G. H. Faulks, G. E. Boehme, D. F. Middleton, Commissioners; and L. C. Milgate, Secretary.

## 3,000-ton Floating Dock at Curtis Bay, Maryland, U.S.A.

### Description of a Notable Extension of the Port Facilities

The United States Coast Guard Yard at Curtis Bay, Baltimore, is extending its facilities in order to provide accommodation for shipbuilding and the repair of vessels. These new facilities, which include shipbuilding ways, shops, piers and a floating dry dock, have been under construction for more than twelve months past, so that the various units are now taking definite shape and some of them have reached the stage of completion.

#### The Floating Dock

The floating dock is of 3,000 tons capacity, being of a longitudinally trussed type, consisting of five sections, with a length over pontoons of 300-ft., length over fantails of 350-ft., an overall width of 84-ft., a width between wings of 64-ft., and providing 20-ft. of water over the blocks.

This longitudinally trussed type was invented by James L. Crandall. It consists essentially of incorporating in each wing the panel of a truss terminating in steel castings, with corresponding lugs at the top and bottom of the chords. As the corresponding lugs are joined by single pins, it is thus only necessary, for the purpose of "self-docking," to remove four

pins, turn a section through 90 degrees and dry dock it on the remaining sections.

The pontoons are of long-leaf yellow pine and the wings are constructed of steel with all seams and joints arc-welded. There are four pumps to a section, one to each watertight compartment, and directly connected to vertical electric motors on the watertight motor deck of the wing. The control for all twenty pumps is centralised in a control house ashore. In this control house are water-level indicators, each adjacent to the control of the corresponding pump, so that the interior water levels of the several compartments may be maintained as desired. This enables one operator to govern the entire pumping operation according to the characteristics of the vessel being dry docked.

In addition to the principal features already outlined, this floating dock is equipped with 32 sliding bilge blocks operated by chains and hand winches located in the wing deck. It also has electric and hand capstans, bollards, flood lights, loud speaker system and other appropriate appurtenances.

The contracting firm for the construction of this new 3,000-ton floating dry dock, was the Tuller Construction Company, of Red Bank, New Jersey. The consulting engineer for the design, as well as for the supervision of the project, was Mr. J. Stuart Crandall, President of Crandall Dry Dock Engineers, Inc., of Cambridge, Massachusetts, U.S.A., who has supplied the foregoing particulars and the photographs accompanying this notice.



Pontoon under construction.



Erection of wings after launching pontoon.

#### Canadian Port Appointment.

Mr. Edward L. Cousins, general manager and engineer to the Toronto Harbour Commissioners, has been appointed by the Canadian Government Maritime Administrator of the Port of

Halifax. The Administrator is empowered by Order in Council to exercise full authority over and to supervise and co-ordinate all activities in the port (except those of the Navy, Army, Air Force and Mounted Police), including those connected with traffic, shipbuilding, ship repair and salvage operations.

## Notes of the Month

### Belfast Dockers Fined.

On July 4th, 27 dock workers at Belfast were fined 40s. each for taking part in a strike contrary to the conditions of the Employment and National Arbitration Order.

### Retirement of Newcastle Quaymaster.

Mr. George H. Watts, Newcastle Quaymaster and Traffic Manager, retired from the service of the City Corporation at the end of June.

### Hull Docks Appointment.

It is announced by the London and North-Eastern Railway Company that Mr. C. H. Nicholson has been appointed docks machinery engineer at Hull in succession to Mr. P. Liddell, who has recently retired.

### Proposed New Wharf at North Sydney, N.S.

It is reported that the Canadian Dominion Government are about to proceed with the construction of a modern wharf, 400-ft. in length, at North Sydney, Cape Breton Island, Nova Scotia. Plans have been approved by the Town Council.

### Proposed Great Lakes Canal.

There is a proposal for the construction of a Canal, 15 miles in length, across Canadian territory to link up Lake St. Clair with Lake Erie. The canal would be 450-ft. wide and the estimated cost is 20 million dollars. It is understood the project is to be financed by the Federal Government.

### American Association of Port Authorities.

At a meeting of the Executive Committee of the American Association of Port Authorities held in Washington, D.C., recently, it was decided that the next Annual Convention should be held from 9th to 12th September next, the place of meeting having been already fixed as the Port of Hamilton, Ontario, Canada.

### Rangoon Port Commissioners.

The Rangoon Port Commissioners have executed a power of attorney in favour of the chairman of the Calcutta Port Commissioners, who will act on their behalf while Rangoon is in enemy occupation. Three port vessels have arrived in Calcutta from Rangoon: a dredger, a fire-fighting vessel and a tug-launch.

### Coal-handling Equipment at Durban.

A new coal-loading appliance, ordered from Britain before the war, has been received at the Port of Durban, Natal, and will be in operation shortly. It will remove one of the greatest handicaps under which the port authority has been labouring in regard to the expeditious despatch of coal and ore from the port.

### Traffic at French Mediterranean Port.

Statistics of traffic at Port St. Louis du Rhone last year show that 263 vessels, of 348,765 tons, arrived, compared with 276 vessels, of 419,386 tons, in 1940. Imports totalled 291,538 tons, against 266,438 tons; and exports totalled 108,240 tons, against 110,498 tons.

### Tees Conservancy Commission.

The Tees Conservancy Commission have decided to discontinue the office of General Manager, vacated by the death of Mr. F. T. Natrass, and have appointed the chief accountant, Mr. Horace James, as clerk and accountant. Mr. James has temporarily, during the absence of Mr. Natrass on sick leave, been acting as clerk.

### Traffic at Port of San Francisco.

According to a statement contained in *Lloyds' List*, extracted from the *Daily Commercial News Business Bulletin*, cargo traffic at San Francisco last year amounted to 5,167,905 tons, in addition to 1,838,211 tons of petroleum and petroleum products. The figures for 1940 were 4,382,260 tons of cargo and 1,931,840 tons of petroleum.

### Scottish Harbour Appointment.

Following the retirement of Capt. George M'Glashan, Capt. Alexander M'Gregor, of Appen, has been appointed harbour master at Arbroath.

### Paid Holidays for Dockers.

The Minister of War Transport has decided to grant the principle of a week's holiday with pay to dock workers employed under the Ministry's dock labour schemes.

### Appointment of Harbour Engineer.

Following the retirement of Mr. Hugh R. Barr, Harbour Engineer of Aberdeen, Mr. John Anderson has been appointed to the position.

### Enlargement of Lake Harbour.

The United States Corps of Engineers have held a public enquiry at Milwaukee to consider proposals for enlarging the outer harbour basin at Racine Harbour, Wisconsin, on the Western shore of Lake Michigan.

### Resignation of Port Manager.

Colonel Marcel Garsaud has resigned his position as general manager of the Port of New Orleans, which he has occupied since September, 1940, and the vacancy has been filled by the appointment of Mr. E. O. Jewell, former Director of Commerce at the port.

### Development of Free Port Area at Fiume.

It has been decided by the harbour administration of Fiume to extend the free port area so as to include space where factories for the manufacture of products from Croatian and Dalmatian raw materials can be built. The products are to be made outside the Italian Customs area for shipment to other Mediterranean countries.

### Pier Reconstruction at New York.

The Department of Docks, New York City, is carrying out alterations to the quay frontage of North River, involving the construction of new piers and sheds at the site of the present Nos. 75, 77 and 80 Piers. The estimated cost is 5 million dollars. The Department is also engaged on the construction of a shed and storage building to cost \$700,000 at No. 14 Pier, Staten Island.

### Laying-up Basin for Shipping at Gothenburg.

The Gothenburg Harbour Board have applied for a government grant of 435,000 kroner towards the cost of a laying-up basin for shipping. The basin is to be situated immediately North-east of the T-Canal near the entrance to the Free Harbour. It will be able to accommodate 10 vessels of a maximum length of 180 metres. The surface width will be 270 metres and a depth of 7 metres will be provided over a width of 230 metres.

### Royal Visit to the Port of Belfast.

During a recent visit to Northern Ireland, the King and Queen made an extensive inspection of Belfast Harbour, including the shipyards of Messrs. Harland and Wolff, Ltd., where they were given an enthusiastic welcome by thousands of workmen. At the harbour, their Majesties were received by Sir Ernest Herdman, the chairman, and members of the Harbour Board with the leading officials.

### Dock Storage Accommodation at Calcutta.

Sanction has been given by the Commissioners of the Port of Calcutta for the erection, at an estimated cost of Rs. 64,165, of additional storage accommodation at Sonai, in the neighbourhood of the docks. An area of 1,750,000 sq. ft. at the site is to be raised to a uniform level. The Government of India will bear a moiety of the cost of the necessary surface drainage and will also defray the cost of the railway sidings to be laid inside the new depot, the Port Commissioners providing the approach tracks to the site at an estimated cost of Rs. 15,780.